METAL INDUSTRY

VOLUME 93 NUMBER 2 11 JULY 1958

Hot Dip Galvanizing

SUCCESSFUL as the Fifth International Galvanizing Conference undoubtedly was, it would, in our opinion, have been even more so if the bread of toil had been leavened with a little more relaxation. To attempt to deal, in three days, with thirty-five Papers especially when some authors read them in full, though admittedly some of them were more in the nature of discussion than formal contributions, is liable to lead to mental indigestion and results to some extent in the stifling of general discussion. These difficulties are by no means lessened when to them are added the problems of coping with three different languages and it must be admitted that this time the simultaneous translations were not up to the high standard associated with previous galvanizing conferences.

In common with all international conferences being held in Belgium this year, one of the main themes for discussion was human progress through technical progress. Due to the difficulty of defining exactly what is meant by human progress it proved a difficult theme for the authors of the Papers to explore and a still more difficult one to discuss. Indeed, as one speaker put it, most of the discussion was confined to technical progress. In view of this it is, perhaps, not surprising that one of the authors, Mr. E. M. Wilson, devoted part of his address to the future of galvanizing. In his opinion, increasing labour costs and shorter hours of work must put hand operation out of court and every possible use will, therefore, be made of automation; this view was also shared by a delegate from the United States.

Automation will obviously call for segregation of work by types as there is a limit to the variety of sizes and shapes that can be processed with a particular conveyor or carrier system. Separate plants, each equipped to handle a particular group of work, will need to be developed and a measure of specialization will be necessary among general galvanizers who will have to pass to each other the work that each can handle most profitably. Such, indeed, is already taking place in the Midlands, where one firm specializes in tube work, another mostly small parts and threaded work, and a third, tanks and structural work.

Delving more deeply into the realms of prophecy, Mr. Wilson visualized that the scheduled load for a shift will, with electronic control, be fed into the plant from a pre-loading area in a pre-arranged sequence that will keep the weight processed at a uniform level and so ensure an even heat absorption and maximum effective bath utilization, with consequent fuel efficiency, low dross formation and high pot life. The pre-treatment tanks will be linked together with fume hoods forming a continuous tunnel leading to the drying oven and thence to the bath, only emerging after galvanizing for inspection on leaving the pot. Thus, apart from loaders at the beginning and loaders at the end, only an inspector and a plant supervisor will be required; the latter to see that the solutions are kept at the correct levels, strengths and temperatures, and that zinc is being automatically fed into the bath in the calculated proportions shown on the electronically controlled programme.

Whether or not such a dream ever comes to reality remains to be seen. One thing, however, is certain. As long as steel is used as a material of construction it will be necessary to protect it against rust. Despite the claims of newer materials, and they are legion, zinc still holds its own and there is no doubt that at the present time hot dip galvanizing is the best method of protection available.

Out of the MELTING POT

In Line

ACCORDING to a recent announcement, the United States Steel Corporation is getting ready to follow the Armco Steel Corporation into the aluminium hot-dip coated steel sheet market. For the initial production, a 48-in. continuous hot-dip galvanizing line has been modified to enable it to switch from zinc to aluminium in from two to three hours. Production costs for galvanized and aluminized steel appear to be similar. Thus it will be only the difference between the prices of aluminium and zinc that will be reflected in the difference in price of the galvanized and aluminized steel. This move by the United States Steel Corporation is an important step in the progress of aluminium coated steel from something that merely formed the subject of numerous patents and other suggestions, to a useful common commercial product. At the same time it is also of interest in connection with certain of the above mentioned patents. In the absence of any definite information it is impossible to connect with certainty the continuous hop-dip coating process to be used with one or other of the patents on this subject. It is rather in connection with the probable future of a patent still in the patent stage that this recent industrial development is of special interest. Had it not been for this move by the United States Steel Corporation, there would have been nothing to suggest that any special significance attached to a patent held by the Corporation in respect of a method of electroplating with aluminium. This patent claims an anhydrous molten salt electrolyte having a preferred composition range of 65 to 85 per cent aluminium chloride, 14·5 to 34·5 per cent alkali metal chloride and 0·5 to 4 per cent alkali metal fluoride. This electrolyte avoids the difficulties of previously-suggested electrolytes of this type in that it produces smooth bright coatings and permits the use of high current densities (preferably 200 to 500 amp/ft²) and thus the plating of steel strip moving at speeds of 400 to 1,000 ft/min. The temperature of the electrolyte is maintained between 450 and 650°F., and anodes of high purity aluminium are used. With the entry of the United States Steel Corporation into aluminized steel production, the above patent can no longer be regarded as just a patent, and an optimistic one at that, being clearly a most useful trick up the Corporation's sleeve, to be brought out once the market for the hot-dip product will have taken shape and grown up.

Available

WHETHER needed or not, a process for the electroless (chemical) plating of chromium has now made its appearance. Like the majority of other chemical methods, it is likely to prove more expensive than conventional electroplating. Like other more expensive methods, however, it will no doubt prove acceptable on the odd occasion or in the odd case where the conventional process is either difficult, unsuitable or simply not available. It is hardly surprising to learn, in view of the success of the electroless nickel plating process, that the electroless deposition of chromium is effected by reduction of a chromium compound by hypophosphite ions at the metal surface to be plated. The plating solution contains a mixture of chromium halides, sodium hypophosphite, and a buffering agent such as sodium acetate or citrate to maintain the *p*H between 4 and 6 or, alternatively, between 8 and 10. Such a bath will deposit chromium at the rate of about 0·14 mils/hr., which is too slow for practical purposes. In the newly developed process, the rate of deposition is approximately doubled by the addition to the bath of a soluble deposition rate controlling agent, preferably oxalic acid or an alkali metal salt of oxalic acid. The function of this addition agent is to reduce the dissolved chromic ions to chromous ions and to form with the latter a complex which can be easily reduced on the surface of the metal to be plated through the action of the hypophosphite ion.

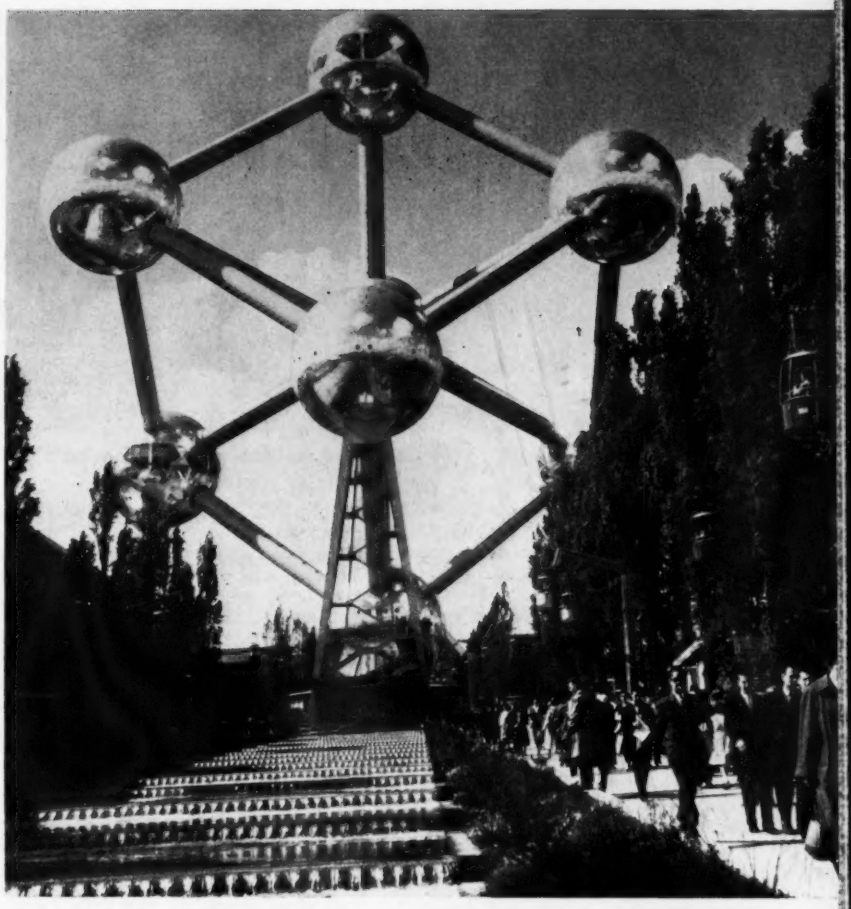
Long Stretch

A NEED for a highly-elastic metallic material arose in connection with the calibration of electrical resistance strain gauges. For this purpose, strains up to 2 per cent are required. This involves the calibration bar (to which the gauges are affixed) to be strained 2 per cent and then unloaded on each calibration run, a treatment which, even with the best spring materials such as phosphor bronze or beryllium copper (limiting elastic strain about 0·5 per cent) would result in fracture after a few cycles. More ductile materials would yield, but would also ultimately fail through overstraining. A way out of these difficulties has been found by making the calibration bar of a "super elastic" alloy. In alloys belonging to this class, stressing at a temperature slightly above a critical temperature results in the appearance of a martensitic phase throughout the matrix. This martensitic phase has the same composition but a crystal structure different from that of the matrix. The regions of this phase increase in size and number with increased stressing. In alloys belonging to the "super elastic" type, the internal stresses resulting from the formation of the regions of the martensitic phase are borne elastically by the matrix, the elastic stresses in the latter causing the disappearance of the martensitic phase when the external applied stress is removed. Alloys known to exhibit this phenomenon occur in the gold-cadmium, indium-thallium, copper-gold-zinc, and copper-aluminium-nickel systems. The last-named system was chosen on the grounds of economy and corrosion resistance. One requirement for super elasticity is that the alloy should be in the form of a single crystal, since in polycrystals much of the martensite formed at high strains is non-elastic. The optimum composition was found to be 3 per cent nickel, 14·5 per cent aluminium, and 82·5 per cent copper. The alloy was prepared by melting the pure constituents in a graphite crucible, and single-crystal bars were grown by slow cooling from the melt. Heat-treatment to produce the high temperature beta phase included homogenization for 15 hr. at 960°C., followed by furnace cooling over a period of 2 hr. to 800°C., and then a slow oil quench. The alloy can be machined by conventional methods, the thin layer of martensite left as a result of surface stressing being removed by etching. Elastic strains of up to 4 per cent could be obtained in these copper-aluminium-nickel bars. A cylindrical specimen of the alloy, subjected to a fatigue test by plane bending with strain limits of ± 2 per cent, withstood 53,000 cycles, whereas under such conditions most materials would fail in 50 cycles or less.

Skimmer

Hot Dip Galvanizing

FIFTH INTERNATIONAL CONFERENCE



ORGANIZED by the Zinc Development Association and the Netherlands and Belgian national associations—Vereniging van Nederslande Verzinkerijen and Belgogalva—on behalf of the European General Galvanizers Association, the Fifth International Galvanizing Conference opened at Scheveningen, near the Hague, on Sunday, June 22. In the afternoon of that day delegates were welcomed on behalf of the Benelux countries by the President of the Netherlands Association, Mr. C. van Kempen, at a reception at the Kurhaus Hotel. The reception was followed by a display of traditional Dutch costumes.

On the Monday, works visits were paid to a number of Dutch galvanizing works, some of which are described elsewhere in this issue, following which the delegates entrained for Knokke-le-Zoute on the Belgian Coast. Here were held the nine technical sessions which are reported in this issue and here too, on the evening of Thursday, was held the banquet. A welcome break took place on the afternoon of Tuesday, June 24, when, following a reception at the Palais de l'Elégance and a fashion show, the opportunity was taken to tour the Brussels Universal and International Exhibition. This exhibition has as its theme a declaration of faith in man's ability to mould the Atomic Age to the ultimate advantage of mankind and like all international conferences being held in Belgium this year, the Conference began and ended with discussions on human progress through technical progress.

On Friday, June 27, a series of visits to various works in Belgium was arranged. Descriptions of some of these works are included in this issue.

During the course of the Conference, photographs and literature on the latest developments in plant construction were exhibited by leading European galvanizing plant manufacturers.

Opening the first session of the Fifth International Hot Dip Galvanizing Conference at Knokke-le-Zoute, **Mr. R. Palmers** (Phenix Works) extended a hearty welcome to the 300 delegates and their ladies who made this the largest conference that the hot dip galvanizers had held. He hoped that they would enjoy their stay on the Belgian coast and the opportunity of visiting the Exhibition at Brussels. He also expressed thanks to the Zinc Development Association and to Mr. R. Lewis Stubbs in particular, who had been responsible for the organization of the Conference.

Expressing thanks, **Mr. E. M. Wilson** (Henry Hope & Sons Ltd.) said that they had been welcomed to Holland by Mr. van Kempen and now to Belgium by Mr. Palmers. Delegates greatly appreciated the warm welcome they had received and they intended to make use of every facility that was open to them. He emphasized the great benefits that had accrued from the formation of the European Galvanizers Association and the close exchange that existed in technical and administrative matters.

Dr. H. Bablik (Brunner Verzinkerei Brüder Bablik) also conveyed the thanks of delegates and commented on the friendly manner in which they had been received. On behalf of the European Galvanizers Association he extended a cordial welcome to all, especially to the ladies accompanying delegates. Twenty-two countries in all had sent delegates to the meeting and although they were competitors they all realized the rewarding effects of progress and the bonds created by technical progress. At the same time he pointed out that there were dangers in technical progress and it should be realized that technology is no more than a tool for living.

At the first technical session, having as its theme "Human Progress through Technical Progress," **Mr. S. K. Bernt** (N.V. Plaatwerkerij en Verzinkerij H.P. Bammens and Zoon) occupied the chair. The first Paper was given by **Mr. R. Palmers** who pointed out that conditions of working in galvanizing shops had of recent years been greatly improved through the technical developments that had taken place in the process itself. Technical advances had also provided the worker with higher rewards and a reduction in working hours.

In a subsidiary Paper on the same theme **Mr. E. M. Wilson** said that in England the efforts of individuals followed by the pressure of public opinion had transformed the "black holes" of 1890 to the working palaces of 1958. Factory Acts had raised the level of the lowest to that of the best. Technical developments in bath heating, fume control and mechanization had all added to the all important factor of human comfort and of those it was probable that mechanization had been

Some of the delegates attending the first of the Technical Sessions at Knokke-le-Zoute

paramount. Looking to the future he thought that the ultimate goal would be complete automation which would make a measure of specialization within the industry inevitable. With the advent of atomic power he predicted that electrical heating would be a severe competitor to all other forms of bath heating. He estimated that while technical progress had reduced costs by 60 per cent, the cost of providing amenities for workers had risen by 300 per cent, so that the balance of cost—an increase of 240 per cent—could be said to have been spent in the interests of human progress.

DISCUSSION

In the discussion that followed, **Mr. F. C. Braby** (Fredk. Braby & Co. Ltd.), referred particularly to the position of supervisors whose job it was to implement improvements of technical knowledge on the shop floor. In Great Britain three conferences for supervisors had already been organized by the Hot Dip Galvanizers Association. These conferences offered opportunities for technical instruction and for the pooling of experiences with problems of personnel. While they gave a review of current galvanizing practice the emphasis was on supervision, particularly on the handling of a galvanizing team.

Other special conferences had been organized by their Productivity Committee for the higher grades of management, dealing with methods of improving production. Before the formation of the Association there had been little contact between individual firms except commercially. He thought that the change in relationships which had taken place and the desire to co-operate in technical matters were evidence of great human progress.

Mr. D. Busch-Jensen (J. Chr. Jensens Galvaniserings Etablissement) thought that the previous speakers had dealt with the subject with laudable optimism but that there were differences of opinion about the exact meaning of human progress. He thought that most people were so absorbed by technical progress that they had little time for the minds of men. There were, nowadays, so many technical conveniences making for easy working conditions and shorter working hours that they were losing the capacity for doing things for themselves; human progress did not follow on higher wages or shorter hours. In his opinion the ordinary worker had too much leisure time and the specialist too little.

With **Mr. G. Piper** (Nordic Circle of Hot Dip Galvanizers) in the chair, the 2nd session was devoted to the subject of the preparation of material for galvanizing and comprised three Papers, abstracts of which are published below.

Efficiency of Hydrochloric Acid Pickling

By F. SJOUKES

THE two main causes of acid loss are (a) drag-out on the articles, and (b) the free acid present in the spent bath. In order to minimize acid loss, the iron content in the spent pickle solution must be as high as possible and the free acid content as low as possible. The acid concentration during pickling does not affect acid loss greatly, provided that the volume of the drag-out loss is not more than about 40 per cent of the volume of the freshly-prepared bath. Iron chloride in the pickle solution has a favourable effect on pickling time, especially at higher concentrations and lower temperatures. In practice, the pickle can be worked down until the $FeCl_2$ content is 240 gm/L. in a cold bath and 290 gm/L. in a bath at 25°C. or warmer. without affecting pickling time.

To obtain a reasonable pickling time, it is advisable to maintain the temperature at 20°C. or higher, so that the acid concentration can be held between 100 and 150 gm. HCl/L. For practical reasons, pickling temperatures should not exceed 40°C. At 20-30°C. the free acid content in the spent pickle can easily be worked down to about 60 gm. HCl/L. or lower.

Using the pickle bath in this way, acid savings of up to 20 per cent can be obtained.

Behaviour of Molten Fluxes for the Hot Dipping Process in Zinc, Tin and Lead

By J. HILLE and W. DURRWACHTER

THE kinematic viscosities of some molten fluxes used in hot dipping processes were investigated using a slightly modified Kampf viscometer. The viscosity of zinc chloride is lowered considerably on addition of alkali halides (NaCl, KCl or LiCl), the lowest viscosities being obtained with additions of KCl.

In systems containing ammonia the viscosity depends very largely on ammine formation and on the ammonium chloride content. Zinc ammino chloride was found to have a very low viscosity that is almost independent of shear stress. The influence of ammines on fluxes is similar to that of alkali chlorides, but the former are chemically and thermally less stable.

In all the cases examined, oxides were found to increase the viscosity of fluxes when the solubility of the oxide in the melt was exceeded. The influence of iron oxides was found to depend upon the degree of oxidation of the iron. Iron ammino chlorides may be formed in a similar way to zinc ammino chlorides, but are useless as fluxes and, in galvanizing, lead to increased dross formation.

Reclamation of Hydrochloric Acid from Spent Pickle Liquors

By R. HAARMANN

FERROUS chloride formed during pickling is precipitated from the spent pickle by adding hydrochloric acid gas and cooling to 0°C. in a separate vessel. The crystals thus formed are separated from the solution in a centrifuge, and the liquor is enriched and used again. The ferrous chloride is then thermally dissociated into hydrochloric acid gas and iron oxide, the gas being fed back into the first stage of the regenerating process. The rate of deposition of ferrous chloride in the crystallizing chamber is dependent on the rate of formation of hydrochloric acid gas in the roasting oven, so that the process may be regulated by setting a flow meter.

Data from two Ruthner plants indicate substantial gains for this reclamation process compared with neutralizing spent acid and discharging it. The smallest throughput for which it would be worth while at present is one of about 1,000 tons of steel per month.

A further advantage of the process is the greater control over the pickling process resulting from the constant acid strength.

DISCUSSION

In the discussion which followed, **Mr. W. L. Hall** (General Galvanizers Ltd.) said that the Paper by Sjoukes referred to the importance of chemical control of the pickling process and quoted figures for acid losses. He thought that the importance of reducing acid losses had been over-emphasized. If washing was not carried out after pickling the acid was not lost; it was an essential chemical in the fluxing process. He agreed that excess carry-over should be avoided by draining. Frequent analyses were not necessary in large baths; once every two weeks was ample. With regard to the heating of pickling acid there were certain technical advantages to be gained from hot acid heat exchangers but adequate methods for the control of fume from warm hydrochloric acid were not at present available.

He asked whether any delegates had knowledge of an economic method of dealing with acid fumes from pickling vats.

He expressed a certain feeling of disappointment with regard to Dr. Haarmann's Paper. While the process described was technically sound it could be a very difficult undertaking for the average galvanizing works. He thought that from the economic point of view the estimates given for manpower for maintenance and control were far too low. He was of the opinion that the process would require more specialist labour and supervision.

He also asked what was the physical space occupied by such a plant, and whether there was any hope of it being adapted for a smaller works dealing with, say, 8-9 tons of steel per month?

In reply, **Dr. Haarmann** (Siegener A.G.) said that at the present time the plant could deal with 2,000-3,000 tons per month but that later it was hoped to develop a smaller size. He agreed that it was a little complicated for the ordinary galvanizer but maintenance and labour were not difficult. The plant operating in Germany occupied a space of 20×8 metres.

Mr. A. Ash (Fredk. Braby & Co. Ltd.) thought that the plant described by Dr. Haarmann would be too costly. He asked for information regarding the size and shape of the iron oxide powder produced and whether any uses had been found for it, such as the desulphurization of coal.

Dr. Haarmann replied that they had tried the iron oxide in a number of applications but they had had, as yet, no success.

Mr. Morgan Davies (Zinc Development Association) referred to a pilot plant which had been running in the United Kingdom for two years, and in which a 90 per cent recovery of acid was obtained. This plant dealt with 100 gall/hr. but to place it on an economic basis 250 gall/hr. would be the necessary minimum. Such a plant would cost about £25,000 and would regenerate acid at 50-70 per cent the cost of commercial acid.

Under the chairmanship of **Mr. R. Gloor** (Kummler and Matter A.G.) the Third Session dealt with the relative merits of wet and dry galvanizing. Abstracts of two Papers which were presented follow.

Survey of Galvanizing Processes

By E. C. MANTLE and P. HOESLI

THE figures collected suggested, that for galvanizing articles such as tanks and cylinders and work of similar weight, the old dry process makes more effective use of zinc than either the modern dry process or the wet process. Whereas the old dry process would be expected to produce much larger quantities of dross than the modern dry process, dross production recorded by the firms working this process is for the most part no greater than that of the firms working the modern dry process. For hollow-ware galvanizing, the wet process appears to be remarkably efficient, though it is open to the objection that there is a danger of flux staining and the possibility of corrosion from flux residues.

Flux consumption was found to vary considerably from plant to plant, bearing little relation to the galvanizing process in use. In many of the plants the cost of the flux used exceeded 5 per cent of the cost of the zinc consumed so that flux consumption is a not inconsiderable item of galvanizing costs.

The dry galvanizing process might be expected to use more labour, but there is no suggestion from the results of this survey that that is so. The output of work per man hour varied tremendously from plant to plant even when the plants were handling the same type of work, and is clearly a function of the organization of the plant rather than the galvanizing process used.

Survey of Galvanizing Processes With Particular Reference to the Efficiency of the Use of Zinc

By H. BABLIK

THE essential difference between dry and wet galvanizing is not whether articles enter the bath with an apparently drier or wetter surface, but *only* whether the zinc bath is alloyed with aluminium or not. This, and only this, is the ruling factor. The reaction between iron and zinc, which leads to the formation of the Fe/Zn alloy layer, is determined by the aluminium addition which essentially depends for its extent on the time of immersion of the article in the bath, the bath temperature and the characteristics of the iron. Dry galvanized coatings, correctly applied, have, therefore, *no* alloy layers.

Apart from zinc losses caused by skimmings and dross, zinc consumption depends above all on:—

(a) the correct concentration of aluminium in the bath. In average conditions this can be taken as 0·1 to 0·15 per cent Al;
(b) on the characteristics of the iron base;
(c) on the immersion time, since this determines the thickness of the Fe/Zn alloy layer. Since the iron content of the Fe/Zn alloy layers is on an average between 6-8 per cent, and the remainder consists of zinc, the zinc consumption is fairly shown by the thickness of the Fe/Zn alloy layers.

Zinc consumption can be correctly judged and estimated only by considering the thickness of the Fe/Zn alloy layer. In view of the thinner layer in the case of dry galvanizing (but again

neglecting skimmings and dross), zinc consumption must in all cases be less in dry galvanizing; but reasonable statements on zinc consumption in dry galvanizing are only possible if, at the same time, the aluminium content of the zinc bath is stated.

Undoubtedly dry galvanizing entails higher costs, and is, if properly carried out, a process that requires more care than wet galvanizing. The surface of the article must be cleaned by washing, since the flux, as used in dry galvanizing is much less active than it is in wet galvanizing. The use of the dry process is, therefore, only logical when easily formed zinc coatings are required, since, owing to the absence of the Fe/Zn alloy layers and the generally thinner layer, these coatings are far more easily formed than those produced by wet galvanizing; but in this case we must reconcile ourselves to the fact that these coatings, being thinner, have a much shorter life, since the protection against corrosion is roughly in linear proportion to the coating thickness. Thus, if there is no need to produce easily formed coatings, or if thinner coatings are unacceptable, dry galvanizing should not be employed.

Proper dry galvanizing with the correct aluminium additions was developed for sheet galvanizing which requires coatings that will stand bending. In the case of hollow-ware, thicker coatings have to be produced than in sheet galvanizing, and therefore, there has been a change towards smaller aluminium additions in the bath which has led partly to making it impossible to analyse the aluminium content exactly, and has partly given rise to the idea that the inhibitive effect is in some way proportional to the amount of aluminium added. This is by no means the case.

Figures for the formation of hard dross can only be rightly understood in their relationship, if at the same time attention is paid to:—

(a) the type of iron (C, Si content, surface property);
(b) immersion time and temperature;
(c) effectiveness of washing treatment.

The important point is whether there has been sufficient washing

(a) with water;
(b) with a correctly concentrated flux wash.

If the iron salts are removed, the amount of hard dross will be less. Moreover, the amount of hard dross can be lessened in wet galvanizing by suitable types of iron, suitable immersion times and suitable immersion temperatures. However, the most important decrease in zinc consumption is obtained by correct alloying of the bath with aluminium.

As a result of the absence of Fe/Zn alloy layers, the zinc consumption is in every case less when dry galvanizing is correctly carried out, but the zinc coating is also in every case thinner. In dry galvanizing it is simply the occurrence of ash that is somewhat greater than in wet galvanizing; but, to sum it all up, zinc consumption is significantly less in correct dry than it is in wet galvanizing; but it has always to be remembered that in dry galvanizing the coating is weaker.

At one of the Technical Sessions: Mr. C. van Kempen, Dr. R. Haarmann, Mr. E. M. Wilson, Mr. R. L. Stubbs

DISCUSSION

Calling attention to one or two points in the Paper by Hoesli and himself, **Mr. E. C. Mantle** (British Non-Ferrous Metals Research Association) said that the considerable variations shown in Table VII were due to the fact that some of the plants were passing through a slack period at the time of the investigation and that therefore it possibly conveyed a false impression of the labour used. He thought that Table VI in the Paper showed surprising results in the efficient use of zinc with reasonably thick coatings and that as regards holloware it appeared that there were economic advantages in using the wet process.

Comparing the maximum dross formation of the two groups in Table V, **Mr. K. Lewus** (Gemeinschaftsausschuss Verzinken) said that it will be noted that all these plants use coke heating. From this it can be concluded that the high dross formation is principally dependent on this type of heating. It is equally probable that the high dross formation is also attributable to stronger local attacks on the pot wall due to irregular heating.

The determinative influence of the type of heating on dross formation is also clearly shown in the two electrically heated pots of plants 5 and 17, in which relatively little dross arises, thanks to the regular heating and in spite of the wet galvanizing process employed.

The amount of dross arising from the pot depends not only on the type of heating, but also on relative throughput. The lower the throughput the higher, under normal working conditions, is the amount of dross formed in proportion to the total amount. According to experience in Western Germany, this part amounts to about 15 to 20 per cent of the total amount of dross formed. In individual cases, however, it may be considerably higher.

A surprising result of the examination is the high zinc coating in dry galvanizing as compared with the other processes. This difference is shown most strongly in the hardware galvanizing group. Here, the average zinc coating amounts to 1·8 oz/ft² for dry galvanizing, and 1·3 oz/ft² in wet galvanizing, corresponding to 550 and 400 gm/m² on one side of the surface. The West German hardware galvanizers on the other hand, produce zinc coatings lying between about 300 and 350 gm/m² and here dry galvanizing shows the lower figures. So far as can be seen, the remarkable difference in practical results between British and West German dry galvanizing lies in the different ways of alloying the bath with aluminium. According to the data in Table III, the British baths contain, by preference, only a small aluminium content, or even none; while bath contents preferred for dry galvanizing in West Germany use about 0·15 per cent aluminium, by which means, using short immersion times, the formation of the iron-zinc alloy layer is considerably inhibited.

The use of fluxes is surprisingly high, the exceptions here being plant 2, which in dry galvanizing hardware uses 2·4 kg/ton throughput in ammonium chloride and zinc chloride together, and plant 15 which in the old dry process requires only 1·6 kg/ton of ammonium chloride for scattering on heavy articles. Standard consumption figures for fluxes in West Germany amount to 1-3 kg/ton in dry galvanizing, and 3-5 kg/ton in wet galvanizing and/or the old dry galvanizing.

In Table VIII we are struck by the high figure for auxiliary labour which on the average is as high as that for galvanizing. It is probable that the largest

part of the auxiliary labour is employed for transport and subsequent work on the articles galvanized. In West Germany the proportion of auxiliary workers to galvanizers is about as 1 : 3 up to 1 : 6.

Correspondingly, the total cost in working hours per hundred tons of throughput is considerably lower.

Dealing with the Paper by Hoesli and Mantle, **Mr. J. R. Rouff** (Association Technique de Galvanisation) thought that it was difficult to compare so many factors. He wondered why the Paper had avoided dealing with the quality of the zinc used. In his experience using zinc of 98·5 per cent purity a dross production of 2·8 per cent was obtained, compared with 1·6 per cent when using zinc of 99·90 per cent purity. In other words use of a better grade of zinc reduced dross production by 45 per cent.

Referring to Dr. Bablik's Paper, **Mr. G. R. Faulks** (John Williams & Sons (Cardiff) Ltd.) said that one practical point that he thought needed emphasis was the distinction between galvanizing to prevent rust and galvanizing to obtain better bend properties. In the United Kingdom they were faced with the demand for thicker and thicker zinc coatings. They were in business to prevent rust and in fact were in some cases asked to double dip to increase protection. The Sendzimir process produced sheets which could be bent through 90° before the zinc coating cracked but the rust protection obtained could not be compared with that given by thicker coatings.

There was no doubt that the dry process improved working conditions and therefore although it had lower zinc efficiency it was to be preferred. One practical difficulty was in keeping the aluminium at its proper percentage in the bath.

With regard to the Paper by Hoesli and Mantle, **Mr. W. L. Hall** agreed that it was difficult to analyse data from a number of galvanizing plants. He thought that the great divergencies shown were largely due to the difficulties of classifying work. He wondered whether a future report might attempt comparison on the basis of the cost of operations without, of course, disclosing the identities of individual plants. Only in this way could the ultimate answer be obtained; namely which was the most economical method of galvanizing; there was no doubt that the dry process improved working conditions, its great advantage being that it reduced fume present in the shop. This was an advantage that could not be measured in terms of money although the process did not, of course, require expensive fume removal equipment.

Replying, **Mr. Mantle,** referred to the differences of opinion regarding the terms wet and dry galvanizing. In his view wet galvanizing was galvanizing with a blanket of flux while dry galvanizing did not use a flux blanket. Dr. Bablik in referring to dry galvanizing meant a process with large aluminium additions. In high aluminium baths there was a tendency for growth of the zeta phase, particularly with long immersion times, giving rough and variable coatings. With slow rates of immersion there was a tendency for bare patches.

He did not agree with Lewus that heating with coke was the chief cause of high dross formation; it was a contributory factor only. Neither was the attack on the pot an important factor in dross production. With regard to zinc quality and dross production, the zinc used in the tests was G. O. B. zinc containing 1 per cent lead and nominally 98 per cent zinc. He thought that iron content was the main factor in dross production and this was, in this metal, very low.

He agreed with Hall that a comparison by cost of production would be very interesting, but he felt that it would still be difficult to compare efficiency.

With **Mr. C. P. H. Wedge** (B. E. Wedge Ltd.) acting as chairman, the fourth session considered the various methods of heating the galvanizing bath. Four Papers, abstracted below, were presented.

Oil-Fired Galvanizing Baths

By J. G. C. POPE

THE grade of oil used varies from the 100 per cent distillate to the heavy fuel oil blend of residual oil and distillate—the higher the viscosity, the cheaper the oil.

The thermal considerations in the design of an oil-fired bath are similar to those for other types; the maximum rate of heat transfer through the walls should not be more than 10,000 B.Th.U/ft²/hr., or the pot may be adversely affected, and for this reason the flame from the burner cannot be allowed to impinge directly on the bath wall. The rate of heat transfer can be satisfactorily controlled by protecting the walls of the bath by a layer of brickwork; by installing a refractory wall a few inches away from the bath, on to which the flame burns—the products of combustion can then be made to pass between this wall and the bath; and by circulating the products of combustion round the bath from an external combustion chamber, after dilution with air or recirculated gases.

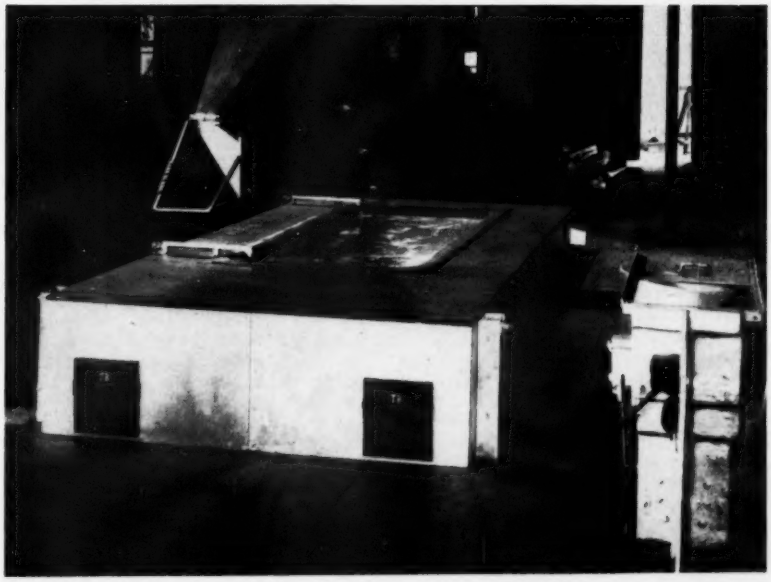
With the third of these systems, the gas temperature is so low that overheating is virtually impossible, the setting design is simple and temperature control straight-forward, since the amount of firebrick is kept to a minimum, and the cheaper grade of fuel is comparatively easy to use since the flow of heavy fuel oil may be more easily controlled to one or two burners than to a multiple burner setting.

Automatic control of temperature is a feature of all modern installations.

With all but the least viscous oils, heating facilities in the tanks are necessary, so that the oil will flow easily from the tank to the burners. The oil must be heated further just before the burners to ensure effective atomization, and line heaters are normally employed; in large installations it may be worth while to circulate the oil through the ring main at burning temperature.

In galvanizing, a high turn-down range is required to cover maximum working and stand-by periods, and it may be necessary to have at least two burners; the large, rapid changes in

Oil-fired galvanizing furnace with 10 ft 5 in × 4 ft × 5 ft bath installed at the Worksop Galvanizing Co. Ltd. by Thompson Bros. (Bilston) Ltd.



heat requirement of the bath also make a firebrick lining to the setting valuable as a source of stored heat.

The operating efficiency of an oil-fired installation should be similar to that of a gas-fired plant, but the fuel cost of the former may be the lower by 30-50 per cent.

Electrical Bath Heating

By A. PARENT

A GALVANIZING bath (7·7 m. long, 0·8 m. wide and 1·2 m. deep) is heated by 120 electrical resistance elements placed in the molten lead jacket which surrounds the zinc pot. The installation is fully insulated.

120 elements are arranged in groups of four for control purposes and these groups are divided into seven "zones". Four thermocouples control the power supply.

Over a period of one year, for an average production of 3·1 tons/hr. (of tube) the average power consumption is 115 kW per ton. In the stand-by period, with the bath covered, the average power consumption is 55 kW.

One bath after processing 14,553 tons of tubes showed a reduction of wall thickness of only 4 to 5 mm. on the long entry side of the bath which receives the most heat.

Top Heating of Galvanizing Baths

By R. HAARMANN

THE need for efficient bath heating in hot dip galvanizing has resulted in the development of induction heating and top-heating methods, coupled with the use of ceramic pots.

In comparing a gas-fired top-heated bath (maximum throughput 500 kg/hr.) with a side-fired installation, it is shown that the no-load gas consumption of the latter is much the higher of the two. The consumption of the top-heated bath, however, increases almost linearly with throughput, while that of the side-fired bath is almost constant until the throughput exceeds 3 tons day; with higher loads, the consumption curves run parallel and close to one another, the side-fired bath having the lower consumption. Temperature distribution was uniform at the working surface.

Top-heating is not economically competitive with side-firing for large throughputs, because of the excessive heating area required for heat transfer. The main advantages of the top-heated bath lie in the almost unlimited life of the pot and in the very low rate of dross formation.

Line Frequency Induction Furnaces for General Galvanizing

By H. CHAPMAN

A SMALL pilot plant of zinc capacity 1,700 lb. and surface area 20 in. × 20 in. was used for galvanizing small articles. The power is supplied by means of a simple transformer with a 460-volt primary coil, the secondary coil being a loop of zinc continuous with the zinc of the bath. The entire installation is lined with refractory.

A wide range of operating temperatures can be used (427°-527°C.). Both the wet and the dry galvanizing processes may be used with this type of installation. Aluminium additions of up to 0·25 per cent have been made; when the aluminium content was more than 0·01 per cent, ash formation was negligible.

The formation of dross was also minimized, since nearly all the dross formed was kept in suspension by the strong agitation of the zinc.

The coatings formed were thinner and more adherent than those found in conventional practice; the aluminium additions suppressed the brittle alloy layer.

The induction furnace may eventually replace other types of bath, for its zinc utilization is very high due to small wastage in residuals.

DISCUSSION

In the discussion which ensued **Mr. G. Piper** (Nordic Circle of Hot Dip Galvanizers) referred to four top-heated and three induction heated baths which had been running in Sweden since 1952 without trouble. The top-fired bath was galvanizing nails and the average dross production was lower than in ordinary installations. In the oil-fired baths, which were originally designed for electrical heating there was a friable brick lining over the top of the bath and the heating efficiency was not more than 50 per cent. In the induction furnaces they had had some trouble with dross formation. They used both the wet and dry processes, the former pickling with sulphuric acid and the latter using 2-3 per cent aluminium. The dross formed averaged 5-6 per cent.

Referring to Pope's Paper, **Mr. J. N. Park** (Thompson Bros. (Bilston) Ltd.) quoted figures showing that oil firing was 30-40 per cent cheaper than town's gas. They had achieved an overall decrease in galvanizing costs of 2½ per cent with increased earnings of 10 per cent for the galvanizing team.

In small installations, said **Mr. J. Leutbecher** (Walter Körner G.m.b.H.) the cost of ancillary equipment for heavy oil installations was high and the capital costs of oil installations must be taken into account when comparing with electric heating.

Dealing with oil-fired installations, **Mr. J. Bradbury** (Incandescent Heat Co. Ltd.) said that circulation rates could be increased with advantage because by that means the temperature of the gases was brought down. He recommended a flow of gas of 85 ft³/sec., a gas temperature of 500-550°C. and a bath temperature of 460-465°C. In a circulation type vat 14½ ft. × 4½ ft. × 11 ft. the stand-by consumption of 200 sec. oil was 4 gall/hr., and 7·2 gall/hr. on production. The problem of brickwork construction had been solved by lining with a special concrete mix which reduces the number of joints and gives an inpermeable surface. The heat loss was satisfactory in that a casing temperature of 120-130°F. was achieved. He advocated the use of self-proportioning burners which provide efficient combustion and low fuel costs.

The importance of turn-down ratio was emphasized by **Mr. F. M. Hodgetts** (Stordy Engineering Ltd.) who said that this was often the chief cause of failure with oil-fired equipment. In his opinion separate combustion chambers were necessary before temperature dilution takes place. His company had developed a recirculating oil-fired combustion chamber in which the products of combustion are brought in at the very front of the combustion chambers, and it was very successful.

Commenting on turn-down ratio **Mr. J. G. C. Pope** (Shell Petroleum Co.) said that in his experience a turn-down ratio of 4 : 1 was essential for low pressure burners though he agreed that with some types of low-pressure self-proportioning burners now available the ratio could be 5 : 1.

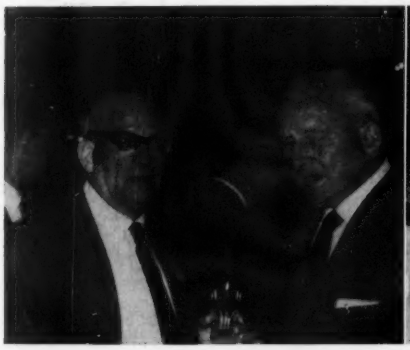
Using heavy fuel oil the oil flow rate should be taken into consideration; a minimum flow rate was necessary to keep the cost of oil burning economic. Even with an allowance of 5 per cent increase in cost for heating the oil it was still cheaper than gas oil. Referring to Mr. Bradbury's remarks concerning the insulating concrete block he thought this a step in the right direction. An alternative was to have a fire brick setting with a high temperature insulating refractory up to 1,300°C. These refractories were light in weight, held little heat and assisted greatly in automatic control. It was possible to reduce gas flow through them by coating on the gas side with refractory cement ⅛ in. to ¼ in. thick. In his personal opinion the best way with heavy oil was to burn the oil separately and then mix with recycled gas at a temperature of 500°-600°C.

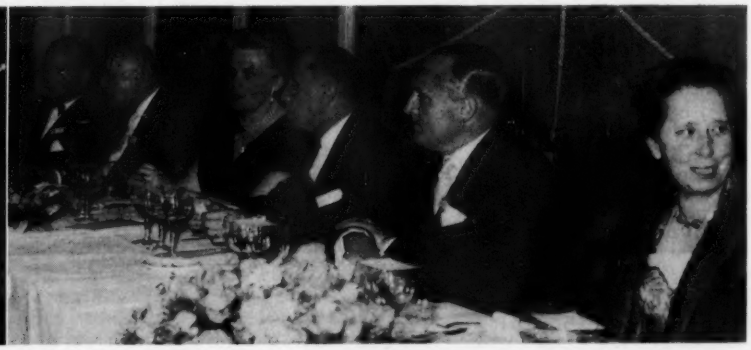
A comparison between the Cook-Norteman and Sendzimir processes formed the subject of the fifth session, with **Mr. Aron** (Chambre Syndicale des Fabricants de Tôle Galvanisée) in the chair. An abstract of the main Paper is given on the following page.

FIFTH INTERNATIONAL GALVANIZING CONFERENCE BANQUET

Mr. and Mrs. R. Dickson, Dr. K. Bayer, Mr. J. Bradbury, Mr. W. K. Etchells *Mr. Lepage, Mrs. M. Brodbeck, Dr. E. Varady, Mr. C. P. H. Wedge, Mrs. R. Gloor*

Mr. S. G. Hardwick, Mr. T. Brown *Mr. Ch. van Kempen, Dr. R. Haarmann, Mrs. Palmers, Mr. A. P. Ollivet, Mr. G. K. Bernt, Mrs. W. Niederstein*





Mr. D. M. Andrew, Mr. L. A. J. Lodder, Mr. C. R. Lyons *Mr. and Mrs. J. A. C. Pope, Mr. and Mrs. A. M. S. Baker*

Mr. F. C. Braby, Mrs. E. R. Faulks, Mr. J. F. H. van Eynsbergen, Mrs. W. A. Jenkins *Mr. J. A. Nimmo, Mr. B. Offerman, Mrs. R. Nolting, Mr. M. H. Davies*

Comparison between the Cook-Norteman and Sendzimir Processes

By H. BABLIK

SOME of the features associated with continuous strip galvanizing—such as the use of exit rolls and aluminium additions to control coating thickness—originated in traditional sheet galvanizing practice but the significant factor in continuous methods is the heating arrangement which allows high throughputs to be achieved.

In the Sendzimir process, heated strip enters the bath and in the Cook-Norteman, induction heating using ceramic pots is employed. There is a marked difference in capacity, however, the larger Sendzimir installations having a maximum throughput of about 20 tons per hour, whereas in the Cook-Norteman process 50 tons per hour can easily be achieved.

Tests were carried out on samples of similar chemical composition from twelve firms (ten using the Sendzimir process and two the Cook-Norteman process). No significant differences were found in the chemical composition of the basis steel, or in the grain size, distribution of carbon, or inclusion content. The mechanical properties of galvanized strip produced in both types of plant were similar, but the yield and tensile strengths were somewhat higher than galvanized hot rolled sheet and cold rolled strip produced in Central Europe. The deep drawing properties were found to be variable and dependent on the history of the steel rather than the galvanizing process. A detailed examination of the coatings shows that the power driven exit rolls employed in the Cook-Norteman process give rise to greater variations in the coating thickness than those obtained in the Sendzimir process. The necessity of controlling the aluminium content of the bath in order to restrict alloy formation is emphasized and determination of the iron content in the coating as a means of control in the Cook-Norteman process is considered unsatisfactory. The turbulence in the induction heated bath causes dross to be retained in the outer zinc layer affecting the analytical control and also concealing the amount of dross actually formed in the bath.

No differences in the bend properties of Sendzimir and Cook-Norteman strip were found; microscopically fine cracks observed after severe bending depend on the orientation of the zinc crystals but no flaking occurs in bending strip over its own thickness. Alloy layers not greater than 5μ thick are necessary to ensure good bend properties. The spangle size of Sendzimir strip is considerably larger than Cook-Norteman strip but it is not known whether this has any influence on formability.

While the relatively rapid tarnishing of continuously galvanized strip is associated with the presence of aluminium in the coating, marked staining of Cook-Norteman strip also results from incomplete removal of flux residues.

DISCUSSION

One of the advantages of the Sendzimir process, said **Mr. T. Sendzimir** (Armco International Corporation, U.S.A.) is that the aluminium-zinc alloy can be added in small frequent quantities. The aluminium is needed near the top of the bath so as to make first contact with the zinc. As the bath is calm there is only a small dross formation.

In the Cook-Norteman process there are three separate operations. First, batch annealing which takes 4-6 days, second, skin passing and third the coating process itself. It is claimed that the structure gives a softer sheet than does the Sendzimir process but this claim is not borne out by Dr. Bablik's results.

In the Sendzimir process there is no acid, no flux and little dross but the chief economy is due to continuous production.

In a contribution read on behalf of **Dr. N. E. Cook**, it was stated that the Cook-Norteman and Sendzimir processes, both having the same goal of producing light coated continuously galvanized material, approach the problem by entirely different methods. There are advantages and disadvantages inherent in each process, and this is just what would be expected since the perfect galvanizing process has not yet been devised. We would like to comment on several points which have been raised.

An important advantage of the Cook-Norteman process is that non-fluting material can be furnished as a standard commercial product from the coating line. The non-fluting properties are incorporated into the basic strip material by temper passing after batch annealing. In coating this material the temperature of the strip is never raised above 850°F., and then only the surface layers of the strip are raised to that temperature. The internal part of the strip between the two surface layers does not attain temperatures higher than 500°F. Therefore, while there is some degree of ageing of the strip while being coated, it is never so pronounced that it cannot be corrected by the cold working of one single backed-up leveller at the exit end of the line.

The most important advantage of induction heat, not mentioned specifically by Dr. Bablik, is that the percentage of aluminium can be quickly varied almost at will. Different types of steel, such as rimmed, aluminium killed and unannealed, and steel with different degrees of cleanliness, require different percentages of aluminium in the bath to suppress alloy layers. In using the induction furnaces, aluminium, in the form of zinc-aluminium alloy, can be added directly to the inductor throats in the bath, where it will melt almost instantaneously and be mixed completely and thoroughly in the bath.

Strip surface has no apparent effect on tightness where proper controls are exercised. We prefer to use the same degree of roughness, within the limits of mills to produce, for all gauges, 10 to 32, inclusive, preferring that it be fairly smooth. There is no difficulty in regulating weights of coating on this smooth strip, from light coatings up to 3·0 oz/ft².

A major advantage of the Cook-Norteman process, particularly in the United States, is that a soft, workable sheet can be furnished, *directly from the line*, and within the full speed range of the line. We can furnish material in the full Rockwell ranges for the reason that the required hardness is produced in the black material and is not essentially altered in the coating process. For many types of work in the United States the customer prefers material in the 40-50 Rockwell 'B' Hardness range, and this can be done easily in one standard processing.

Dr. Bablik has made some interesting points regarding the occasional variation in thickness of the coating layers on the two sides of the sheet. We quite agree that all factors mentioned will influence this condition. From our experience we are inclined to believe that the major cause is the variation from the symmetrical arrangement of the coating rolls with respect to the moving strip. In any continuous coating process the strip should follow a perfect vertical path from the last sink roll up through the coating rolls, and the coating rolls should be perfectly level. The exact placing of the coating rolls with relation to the sink roll is most critical, particularly at high speeds. Even the slightest positioning of the coating rolls off the pass line will result in coatings being different on the two sides of the strip. Another contributing factor is in the use of coating rolls which are not perfectly surfaced, or which are not perfectly round. When the strip is conveyed through the process under very high tension, such as in the Cook-Norteman process, there is not too much danger of the fluttering of the strip. However, a fluttering coating roll drive may, especially at high speeds, be a contributing factor.

Dr. Bablik has explained the cause of "striping" on sheets which he has examined from our process. Other producers, using other processes, are now very generally producing "striped" coatings. The stripes come, of course,

from very high speeds, types of grooving, and operation of the coating rolls at slower speeds with relation to strip speeds. We recognize that these areas have lighter coatings than average coatings on the entire strip and, from a theoretical standpoint, we quite agree that it appears that coating is being wasted. As Dr. Bablik has pointed out, it does not follow that all strip made at very high coating speeds must necessarily have stripes. These stripes can be substantially eliminated at all speeds, and Dr. Bablik has witnessed the coating of strip at speeds of 320 ft/min., which was practically stripe free. We have a most interesting commercial angle in the United States in that the great majority of our customers prefer the striped appearance, even knowing that some areas of the coating are lighter than others, and we are having very great difficulty in selling our trade on non-striped material.

We agree that sheets produced in a fluxing system may be slightly more susceptible to initial, multi-coloured, staining than sheets made without fluxing, if the last traces of flux have not been removed, which may be done by water washing or by washing in weak phosphoric acid solution. From a practical standpoint, however, research has shown that there is very little difference in staining of any sheets, produced by any process, unless some after-treatment is applied to retard the staining. Insofar as the fluxing problem is concerned, we find that when we introduced the prefluxed material into the coating bath at temperatures between 350° and 500°F. we find very little difficulty in minimizing flux problems. We have devised mechanical means for preventing the carrying through of the flux. We have also devised an after-treatment which has as one of its essential components, phosphoric acid, and this assures removal of any traces of flux. The problem of flux carry-through causes us so little concern that we are now engineering a new continuous line which will have strip speeds of at least 500 ft. min through the process.

In the second part of this session, covering surface treatment of galvanized coatings, with particular reference to sheet, the main Paper was presented by Mr. P. Morriset (Chambre Syndicale des Fabricants de Tôle Galvanisée).

Session VI, under the chairmanship of **Mr. A. Jorgensen** (A/S Nordiske Kabel-og-Traadfabriker), dealt with variations in the characteristic of steel wire as a result of hot dip galvanizing. The Papers presented under this title were by B. Ulrich (Nederlandsche Kabelfabriek) and F. Baldi, G. Garbelli and A. Pirozzi (Acciaierie & Ferriere Lombarde Falck).

With **Dr. R. Haarmann** as chairman, three subjects were considered at the seventh session. They were: The effect of impurities and additions on the galvanizing bath; the effect of steel composition on the galvanized coating; the non-destructive testing of galvanized coatings. Abstracts follow.

Oil-fired bath for general galvanizing by David Etchells and Son Ltd. This bath 16 ft × 4 ft × 5 ft. 6 in, has a floor level drying plate heated by waste gas

Influence of Aluminium, Lead and Iron on the Structure and Properties of Galvanized Coatings

By J. J. SEBISTY and J. O. EDWARDS

FOR the experimental conditions studied, immersion time and aluminium content of the bath had the most significant effect on such factors as coating weight, iron content in the coating, steel weight loss, iron-zinc alloy thickness, proportion of alloy in the coating, and ductility and adherence of the coating. The bath temperature was also significant but, in general, to a lesser degree.

With respect to surface appearance characteristics, the only galvanizing variable which exerted a consistent significant effect was the lead content of the bath.

The addition of 0·2 per cent aluminium to iron-saturated baths was effective in largely blanking-off attack of the steel base for immersion times up to 2 minutes.

On the other hand, 0·1 per cent aluminium promoted vigorous steel attack and continuous alloy growth even at short immersion times.

Accelerated corrosion tests suggested that aluminium had a significant effect in promoting "white rusting", and this applied to a lesser degree to the lead content of the bath.

In sheet galvanizing, where the coating thickness can to some extent be controlled by manipulation of the exit rolls and withdrawal speed, the results suggest that short immersion times and high aluminium content will produce better quality sheet apart from the tendency to "white rust."

Under properly controlled conditions it should be possible to maintain a low level of dross formation in dry galvanizing.

Influence of Steel Quality on the Thickness of the Zinc Layer in Hot Dip Galvanizing

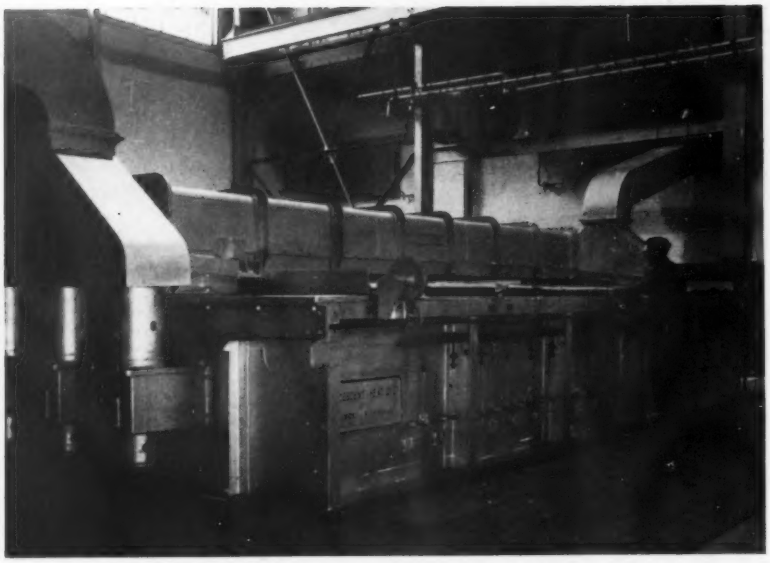
By W. GERBER, R. GLOOR and H. OERTLI

FOR effective under-water protection, galvanized coatings must be heavier than those obtained in normal practice.

Coating thickness was found to increase with silicon content of steels ranging from 0·05 to 0·73 per cent, and also with immersion time, the latter being particularly important with the steels of higher silicon content.

In fabricated articles it is important to have a similar coating thickness on the weld seam as on the rest of the article. In the case of one steel, the proper choice of welding electrode resulted in galvanized coatings on the seam, comparable with those on the basis material for all immersion times examined.

A coating thickness of 0·3 mm. will provide good under-water corrosion protection; such a coating was produced on steel of 0·38 per cent Si, with an immersion time of 8 min. at a temperature of 450°C.



Direct fired galvanizing bath 20 ft × 6 ft × 10 ft deep designed and built by The Incandescent Heat Co., Ltd.

DISCUSSION

Commenting on the Paper by Sebisty and Edwards, **Mr. E. C. Mantle,** said that the section dealing with the influence of aluminium, lead, and iron duplicated work previously done by the B.N.F.M.R.A. and while it confirmed their findings he pleaded for better co-ordination of research in this field. The presence of lead had no effect on the structure, coating weight, ductility or corrosion resistance. It did, however, facilitate the production of smooth galvanized coatings. The dipping time employed by the authors was not representative of continuous galvanizing practice. Their method of stripping was also suspect where work concerning the effect of aluminium additions arises. The alloy layer does not dissolve in the stripping acid so that the weight loss appears lower than it really is. Surface roughness has an important influence on coating weight and the ductility of the coating. He was also doubtful of the validity of the results of the accelerated corrosion tests. It would be much better to wait for the results of atmospheric tests.

Commenting on the variation in zinc coating on galvanized sheet, **Mr. C. P. Svensgaard** (A/S Glud & Marstrands Fabriker) said that when the sheet was coated again the regalvanized layer became uneven and that therefore, the variations must be due to the surface of the steel sheet.

A colorimetric method for the determination of iron and aluminium in zinc was described by **Dr. E. Varady** (Associazione Italiana Zincatura).

Non-Destructive Testing of Galvanized Coatings

By W. PEPPLER

THE nature of a galvanized coating is determined by its thickness and structure which are affected by all the factors involved in the galvanizing process and which determine the field of application of the galvanized article.

The structure of the galvanized coating can be influenced only to a very limited extent independently of the coating thickness. Coating thickness alone therefore—which can be determined by non-destructive methods —will also give an indication of the structure of the coating.

The conception of coating thickness is closely examined, and it is shown that the metallographically recognizable coating thickness and that determined by electro-chemical or magnetic methods differ only slightly from the total coating thickness (beginning at the 0 per cent Zn level) and for all practical purposes represent the actual coating thickness.

The various methods of measuring coating thickness, destructive, partially destructive or non-destructive, are examined and particular attention is paid to local electro-chemical removal of the coating and to magnetic gauges.

Gauges known and used in Germany for magnetic measurement of coating thickness in the range 0-0·3 mm. are described, and an assessment of their reliability in measuring the thickness of homogeneous nonmagnetic foils under various conditions is given.

The calibration curves of all the gauges are very similar and, with the exception of the simple magnetic gauge at the lower range, show a linear relationship between the indicated and real foil thickness. Factors which influence the magnetic permeability (such as carbon content) as well as the shape and size of the test piece, are shown to influence the accuracy of measurement. These effects can, however, be nullified if the gauge is adjusted on a test piece of the same shape and size and nature as the material to be examined. However, with section thicknesses of at least 6 mm. and level surfaces of at least 100×100 mm. with the gauge placed centrally, the effects due to area and section thickness are negligible. With two-pole gauges, the magnetic mean value for non-uniform coatings is lower than the arithmetic mean of the coating thicknesses under the individual poles when these are markedly different.

In general, it has been shown that magnetic methods of measuring homogeneous non-magnetic foils are accurate provided that certain simple precautions are observed.

DISCUSSION

Referring to the Paper by Prof. Peppler, **Mr. W. R. Thompson** (Painter Bros. Ltd.) said that it was impossible to obtain accurate readings unless the instrument was zeroed on the base metal. It was not a practicable instrument for shop use because it only determined the thickness of the coating at each point of contact. He suggested that it should only be used as a guide, preferably with the older method of weighing. He went on to describe a new type of Beta ray back scatter gauge which can be applied directly to galvanized members having surface temperatures up to 350°C. It examines an area of about 1·5 in², measures the zinc content of the combined zinc and alloy layers, and displays the results on a meter calibrated to read directly up to 4·5 oz/ft² of zinc coating density. Each measurement takes less than half a minute and the accuracy, when compared with the chemical stripping method, is within ±5 per cent over the range 0·5-4·0 oz/ft². The present gauge uses strontium 90 as the radioactive source but if this were replaced by one of promethium 144 the gauge would then measure coatings within the range 0·02-0·18 oz/ft².

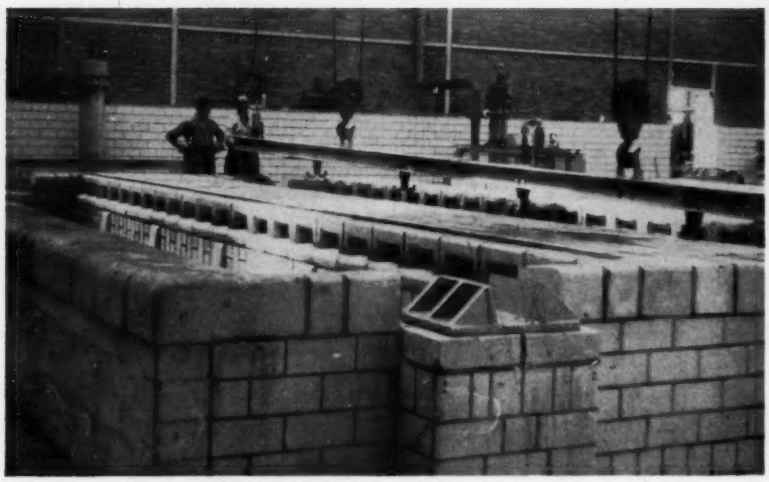
The precautions that had to be taken when using magnetic gauges, said **Mr. E. C. Mantle,** emphasized the difficulties in using the instrument for routine testing. The gauge had to be zeroed on coatings of comparable type, on sheet of the same thickness, on areas not less than 2 in² and there were also difficulties associated with curved surfaces and the roughness of the basis steel.

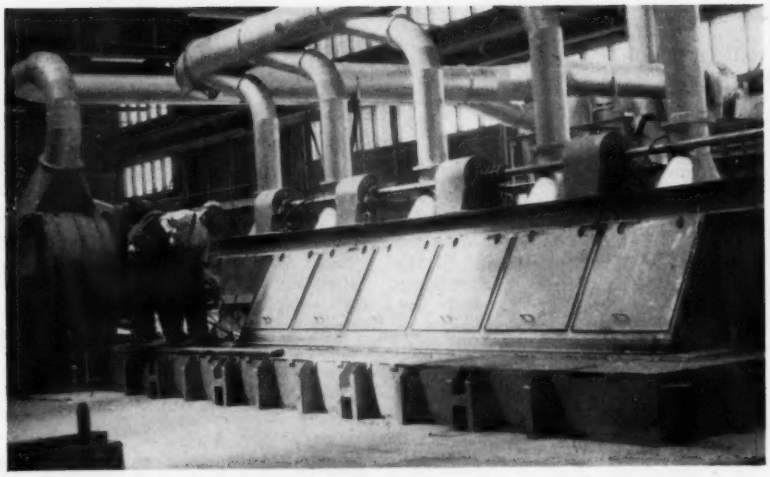
The main theme of the conference "Human Progress through Technical Progress" formed the subject of the eighth session, which, together with the session dealing with mechanical handling, will be reported in our next issue.

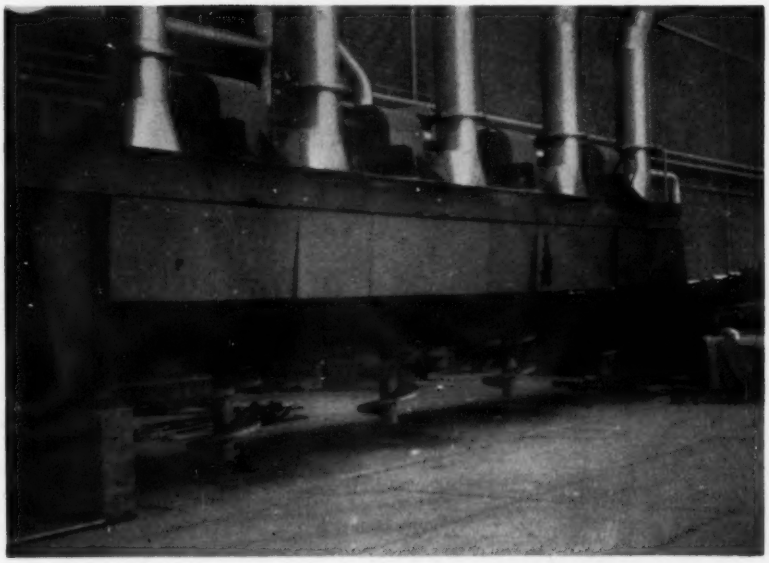
(To be concluded)

Works Visits

N.V. Metaalbuizen-Fabriek Mij. "Excelsior"







PART of a new plant at Oosterhout for making welded and rolled tube from ½ in. diameter to 4 in. diameter, the galvanizing installation of Metaalbuizenfabriek Mij. "Excelsior," has a capacity of 6 tons/hr. The sequence of operations through the plant is given below, the suppliers of the pickling plant being Keramchemie, Siershahn; the galvanizing installation was built by Walter Körner of Hagen, Germany and the automatic regulating equipment was supplied by Siemens-Nederland of the Hague.

Tubes arrive singly at the ingoing end of the pickling plant where they fall into a tray. They are then made into bundles, lifted with chains, and submerged in one of the two pickling tanks, containing sulphuric acid, concentrated 2-15 per cent by weight. After that, tubes are cold rinsed, hot rinsed, and dipped in a hot solution of zinc ammonium chloride with a specific gravity of about 1·25.

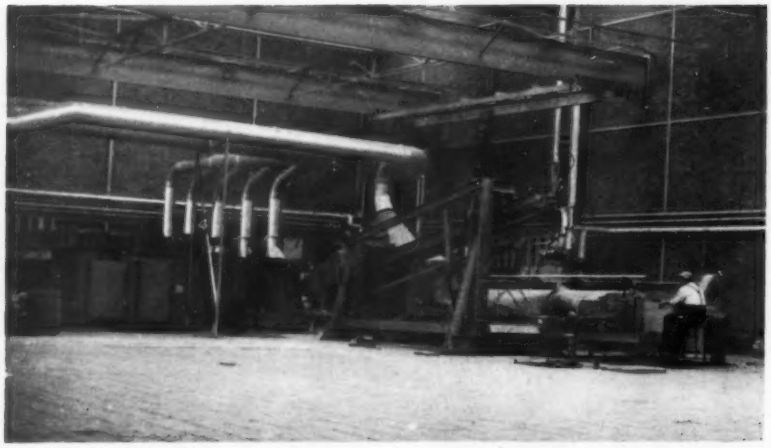
The tubes are then laid on a bridge and mechanically picked up one by one, being conveyed by roller table to the galvanizing plant. There they are pushed on a moving bridge, dried and preheated to about 120°C. From this bridge, the tubes fall upon two transportation screws which immerse the tubes slowly in the molten zinc.

After immersion in the galvanizing bath the pipes are picked up by hand with a hook and moved to a magnetic roll. This draws out the tubes and moves them through an air blowing ring, which wipes off the excess zinc on the outside. The material is then

Top: Pickling plant, showing ceramic lined tanks with exhaust holes, in background heat exchangers and fluxing liquor filter

Centre: The galvanizing tanks

Bottom: The exhaust hood removed from the galvanizing tanks showing the screws of the immersion device



General view of the galvanizing plant showing, left to right, the drying furnace exhaust, galvanizing pot, withdrawing machine, steam blow-out, quenching tank and control desk

moved against a super-heated steam nozzle, which blows away any excess zinc inside the tubes. Finally the pipes are quenched in a water tank and, if necessary, conveyed to the straightening machine.

The tanks of the pickling plant are made of concrete lined with acid-resisting ceramic tiles. Pickling and fluxing liquors are heated in heat exchangers, the condensed steam from these being used in the hot rinse tank. Rinsing waste water is continually neutralized with lime in a conical neutralizing installation.

Waste liquors from the pickling tanks are neutralized and oxidized to a *p*H of about 8. Water flows off clear, iron being separated in a settling tank. Continuous filtration is used for the flux.

The galvanizing tank is gas-heated, the eighteen burners being so arranged as to avoid their flames contacting the tank wall. Heating is fully automatic, the temperature being controlled at 445°-455°C. Manual temperature regulation is, however, necessary at the end of each shift, because of the latent heat in the furnace brickwork.

Microscopic examination of the coating as well as the normal tests is frequently made. A magnetic gauge is used for comparison of abnormal spots and their neighbourhood, as a special difficulty in using this method is due to the fact that pipes are magnetized by the conveying magnetic-rolls.

Phenix Works Flémalle

SPECIALIZING in coated sheet the main products of Phenix Works are galvanized sheet, and tinplate. At present "Skinplate," a sheet on which the protective coating consists of a plastics material is being developed.

The Company also produces to the requirements of its customers thin uncoated sheet intended for pressing.

Additional products include galvanized household goods, drawn parts intended for enamelling, lead coated sheet, coated by passing through a machine with rollers immersed in a bath of molten lead, galvanized roofing accessories: bolts, hook bolts, gutters, etc.

First established in 1881 as a galvanizing shop for the treatment of sheet in Liege the Flémalle-Haute site was chosen in 1905 for the building of the new works, the facilities in Liège having become insufficient.

In 1910 the Company was amalgamated with the Usines du Phenix, at Roux, and formed the Société Anonyme Phenix Works, the only activity of which, up to 1925, remained the galvanizing of thin sheet. At that time the first hot mill was installed, its output being doubled in 1930.

In 1935, in order to provide sufficient work for its mills, in spite of the closing of certain markets, Phenix Works undertook the building of a works for the production of tinplate, and at the same time modernized its hot mill by installing mechanized mill trains.

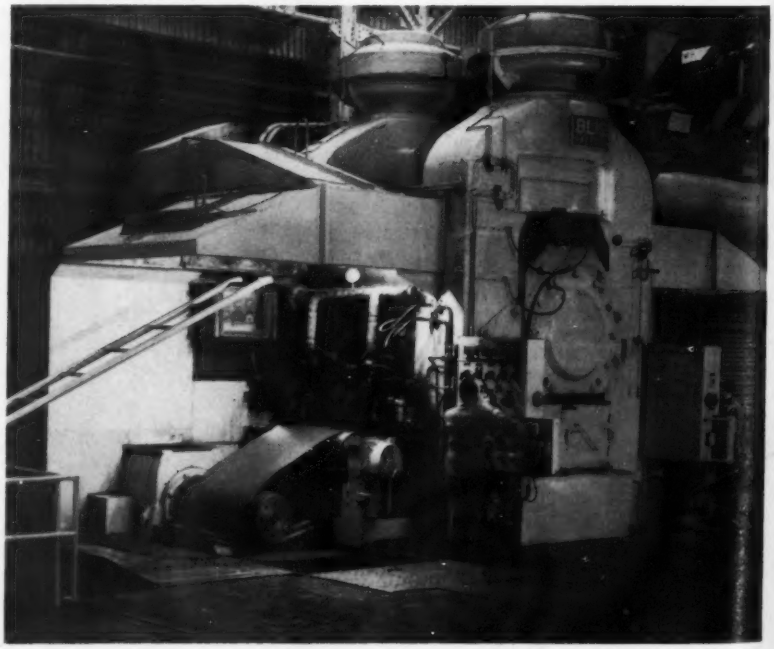
Up to 1949, this plant remained the only one of its type in Belgium.

In 1950, the adoption by the leading producers of thin sheet of the continuous cold strip rolling process, induced Phenix Works to acquire a modern reversible 48-in. cold rolling mill and its ancillary equipment: four-high temper rolling mill, pickling line, furnaces, etc.

In 1952, Phenix Works put into operation a controlled atmosphere normalizing furnace. The galvanizing capacity for sheets was increased in 1954, and a continuous machine for corrugating these galvanized sheets was acquired.

After having achieved satisfactory production from its first cold rolling mill and performance of its extensive

One of the Bliss 4-high cold rolling mills



The Sendzimir—Heurtey continuous galvanizing line

ancillary equipment, Phenix Works installed, in 1956, a second cold rolling mill which can be backed economically by the ancillary equipment already in service, the capacity of which is sufficient to ensure the output from both rolling mills.

To keep the production of galvanized sheets up to its standards and in order to benefit as much as possible from the reduced costs of production through the use of a continuous process, the Company put into operation at about the same time a Sendzimir continuous strip galvanizing line.

It comprises, as compared with the installations being used by American Rolling Mill Co. (Armco) and the majority of its licensees, a number of typically European features which ensure the maximum production economy by recuperating part of the heat of the annealing furnace.

The galvanizing line has given so much satisfaction that the Board has recently decided to install a second line of the same type but of a larger capacity.

Work on the buildings and on the construction of the equipment are being actively pursued, and the new unit will be put into operation in a year's time.

Phenix Works, who had introduced into Belgium the British mechanical method of galvanizing in its works at Roux, undertook in 1938 the production of tinplate which had been in abeyance in Belgium since the beginning of the century.

Use was made of the hot-dip process in which the sheets are passed through a bath of molten tin after suitable preliminary treatment to ensure adhesion of the coating.

These installations have since been perfected and an additional tinning line was installed in 1956.

The Company has taken an interest since 1954 in a process developed in the U.S.A. by the U.S. Rubber Company for the coating of sheet with polyvinyl chloride (p.v.c.).

This process results in such excellent adhesion between a film of plastics and the metal that the latter can be deformed, bent, and even deep drawn without the stresses being able to cause a separation of the two constituents of the new metal-plastics material.

N.V. Nederlandsche Kabelfabriek

ESTABLISHED in 1937 at Alblasserdam, between Rotterdam and Dordrecht on the river Noord, the steel works of N.V. Nederlandsche Kabelfabriek has rolling and other facilities for producing hot and cold rolled strip, and also the galvanized round and flat steel wire for the cable making facilities at Delft which comprise three large plants, viz. two 500,000 sq. ft. plants for the manufacture of all kinds of power and telephone cables and one 100,000 sq. ft. copper rod and wire mill for rolling quarter inch and heavier rod at the rate of about 20 tons/hr. and for drawing to smaller sizes.

The Alblasserdam plant now comprises a steelworks having two 25-30 tons electric arc furnaces of about 8,000 kVA and one of 35-40 tons of about 15,000 kVA rating.

There are also installed two producer gas-fired O.H. furnaces and one oil-fired all basic O.H. furnace, all of 35 tons capacity.

The steel plant has a yearly capacity of about 200,000 tons.

Four 50-10 tons casting and 15 tons semi-portable stripper cranes serve the casting bay which originally produced ingots of about 360 lb. each only. These ingots are bottom poured and up to 36 are cast at a time, every cast taking five 36 mould plates and a few smaller ones. The small ingots are just the right size for the three-high breakdown mills designed to roll billets and 5 in. slabs. This operation is now gradually being replaced by the new continuous billet and slab mill which, however, takes 1,100 lb. ingots of some 8 in. square. These are cast in sets of 12 normally.

From the 1,100 lb. ingot-storage the ingots are charged into the first of a later set of 2 three-zone oil-fired double-row heating furnaces of 30 tons capacity each. On the discharging end the ingots drop on a roller table to a six-stand billet mill, driven by a 4,400 kW 6,000 V. motor. Twisting between the stands is done automatically and without stopping the ingot, the bar being free from the rolls in between the stands.

The bar then drops on a low lying roller table, which is running backwards under the spindles between the roll and pinion housings. The bar is then again tilted on to the first mentioned roller table, is eventually cropped by a 300 tons shear and gets another 4 or 6 passes in the same stands. The finishing speed is 600 ft/min. and the billet or slab is cut in a second 300 tons shear and runs to the first of a future set of two hot beds, from where the billets or slabs will be taken by crane either to the billet heating furnaces of the rod mill or the strip mill, or to the billet storage bay right behind the hot bed.

The continuous strip mill, except for a few later additions, is part of the original 1938 rod and strip mill. It normally produces strip from 1½ in. to 4 in. wide. This strip mill still has the original double row 15-25 tons 360 lb. ingot heating furnace as well as the 1,100 h.p. 20 in. 3-high breakdown mill, the billet/slab heating furnace and the two-stand 18 in. 3-high looping mill, to which a third 16 in. stand with a 400 h.p. motor was added later.

Then follows a 5-stand continuous two high 12 in. intermediate train (with an edging stand in between) all driven by separate 200-300 h.p. D.C. motors and finally a second edging mill plus five separate 350 h.p. D.C. driven 13 in./9 in. 3-high finishing stands. The finishing speed on the looping floor is up to 3,000 ft/min. Three horizontal coilers, a conveyor belt and a cooling bed are the final parts of this equipment. A 2,000 kW 300/600 V. generator set serves the 12 continuous stands

Incoming materials for the continuous rod mill start as bundles of billets 30 ft.

long which are deposited on a moving beam separating table, at the bottom end of which they are fed, two or three at a time, into the 30-45 tons two-zone oil-fired billet heating furnace. A furnace cross pusher feeds the billets into the three-strand mill, which consists of an eleven-stand 18 in.-16 in.-14 in. roughing train driven by six 900 h.p. D.C. motors, three flying shears, which cut off head and tail automatically, four 12 in. continuous and two 12 in. looping stands of the intermediate train, driven by another set of six 900 h.p. motors and finally the bars run via an S-shaped repeater to the 2,000 h.p. 6-stand 10 in. finishing train. The finishing speed is up to 5,000 ft/min.

The hot mill building, in which there is also some rod and all the hot-strip storage, is about 1,500 ft. long and 125 ft. wide. Over a length of 1,250 ft. there are no columns in the middle. Two parallel overhead crane routes of 60 ft. span, each carrying three 15 or 7½ tons cranes are supported in the middle of the bay by a structure hanging in the roof. On this structure is also attached the hook conveyor returning from the end of the building. Hooking-off can be done towards each of the crane routes. Adjacent to this mill bay are the roll turning and grinding shops, the mechanical and electrical maintenance shops and the spares storage rooms. Rod storage in the open is alongside the crane viaduct near the river and in between this outside storage and the hot mill bay are the rod pickling plant, the wire mill, the galvanizing and patenting departments and also a heavy 300 by 100 ft. three storied building with six large platforms to the river wherefrom finished products are picked up by 200 ft/min. 3 tons harbour cranes of 76 ft. span.

On the other side of the hot mill bay are the strip pickling plant, the cold rolling mills and the black and bright annealing departments.

N.V. Plaatwerkerij en Verzinkerij

FOUNDED at Geertruidenberg (North Brabant) in 1850, the works of the N.V. Plaatwerkerij V/H P. Bammens and Zoon at Maarssen have grown from a small smithy into an integrated factory producing a range of fabricated and galvanized holloware. As the business expanded, the original building was extended to become a small factory, the early production including, among other things, stove pipes and stove plates. It was in 1875 that the first hot dip galvanizing was undertaken and from that time onwards, galvanized holloware became a regular item of the firm's output.

In 1917 the business changed hands, and in 1919 the factory was transferred to Maarssen. This move initiated the steady growth of the business and the works now occupies some 21,000 square metres, and employs nearly 400 men. The site at Maarssen was chosen because of its central position and the facilities provided by the Amsterdam-Utrecht main road, and the Amsterdam-Rhine canal.

One of the largest galvanizing plants in Holland, the installation at Maarssen has four galvanizing baths, two of which are 42 ft. long. Pickling is carried out in a diluted solution of hydrochloric acid. Certain special products are subjected to further treatment after galvanizing, such as a modified chronak treatment, Bonderizing, etc.

Much of the work passing through the galvanizing plant is produced in the firm's sheet metal department and this includes buckets, basins, wash-tubs, watering-cans, and dustbins. The sheet metal department also produces manure tanks and pumps, pallets, gutters and gutter-pipes as well as other fabrications in steel, stainless steel and aluminium.

General galvanizing is also undertaken, this type of work including heavy beams for Netherlands Railways, high transmission towers, coolers, ventilation shafts and pipes for the shipbuilding industry, steel constructional work and numerous smaller items. In addition to hot dip galvanizing, the firm also carries out electroplating, zinc spraying and Sherardizing.

General view of the works of N.V. Plaatwerkerij en Verzinkerij V/H P. Bammens and Zoon at Maarssen

Industrial News *Home and Overseas*

An Amalgamation

It has been announced by **Alar Limited** and **The Federation of Light Metal Smelters** that they have amalgamated and will continue to carry on their activities as from Tuesday of last week (July 1) under the name of **The Association of Light Alloy Refiners and Smelters Limited.**

The members of the association so formed are:—Associated Lead Manufacturers Ltd., Atkins "Metals" Ltd., B.K.L. Alloys Ltd., John Cox and Sons (Metals) Ltd., John Dale Ltd., Enfield Rolling Mills (Aluminium) Ltd., The Eyre Smelting Co. Ltd., J. Frankel (Aluminium) Ltd., International Alloys Ltd., John E. Moore Ltd., Norton Aluminium Products Ltd., T. J. Priestman Ltd., Wigley Aluminium Ltd., The Wolverhampton Metal Co. Ltd.

The council of management consists of: Mr. R. Hahn (chairman), Dr. J. Jacobi (vice-chairman), Mr. B. Endlar, Mr. O. G. Halliwell, Mr. R. Hopkins, and Mr. E. W. Nicholls. The preparation, publication and dissemination of technical information previously undertaken by Alar will be undertaken by the new association, and the technical advisory office at 3 Albemarle Street, London, W.1, will continue under Mr. F. H. Smith, technical officer. The registered office of the association is at 1 Frederick's Place, Old Jewry, London, E.C.2.

Golf Tournament

Temple Golf Club, Hurley, Berks., was the venue of the annual golf tournament of the **Aluminium Development Association** recently. The Horace Clarke Cup, played for in the morning, was won by Mr. J. D. King (The British Aluminium Co. Ltd.) and the runner-up was Mr. W. A. Gardner (Aluminium Laboratories Ltd.), who was closely followed by Mr. E. H. Laithwaite (The British Aluminium Co. Ltd.).

In the afternoon a foursomes competition was held, the winners being Mr. S. W. Almond and Mr. W. J. Price (first pair); Mr. H. E. Jackson and Mr. W. Moulding (second pair); Mr. J. H. Mayes and Mr. R. O. Bearcroft (third pair). At the dinner which followed in the evening, and at which the hosts for the occasion were Imperial Chemical Industries Ltd., Metals Division, the cup and other prizes were presented by Mr. S. E. Clotworthy (Northern Aluminium Co. Ltd.), the President of the association.

Electronic Equipment

To mark their appointment as the U.K. distributors of the Beckman Berkeley and Berkeley Helipot, of U.S.A., electronic equipment for industry, a series of demonstrations for directors, scientists, engineers and chief executives is to be held at the works of **Winston Electronics Ltd.**, Shepperton, Middx., each day from July 15 to 18 inclusive, commencing at 9.45 a.m., of a selection of the 200 Berkeley items of equipment of interest to many phases of industry. British, American and German engineers will explain and demonstrate the equipment.

New Aluminium Plant

Put into operation in March last, the new Norwegian aluminium smelter, Mosjoen Aluminium A/S (MOSAL), has now reached full production. Output is to be about 20,000 tons annually. The plant has been so designed that capacity can be expanded to about 30,000 tons a year by making relatively small additions to existing facilities if and when additional supplies of electric power become available, and there are tentative plans for a further expansion of capacity to nearly 100,000 tons annually.

It is understood that this new plant has no sales problems, as its production has been sold ahead for ten years, all of it for export.

Tin from Malaya

According to statistics recently issued in Singapore, tin shipments from Malaya in June totalled 716¼ tons, compared with 691¼ tons in May and 1,168 in June last year. Of last month's total, the United States took 225 tons, Europe 106, Japan 256, the Pacific 3½, India 11½, South America 23, Africa 0·25, Australasia 90¼, and the Middle East 1¼ tons.

Shipments from Penang during the month totalled 2,355¼ tons, against 3,390½ in May and 3,822¾ in June last year. Of the Penang June 1958 shipments, the United States took 1,458 tons, Europe 24, Canada 50, Japan 200, the Pacific 5¼, India 142¼, South America 74¾, Africa 82, Australasia 83, and the Middle East 20 tons.

Non-Ferrous Club

On Wednesday of last week, the July luncheon meeting of the **Non-Ferrous Club** was held at the Queen's Hotel, Birmingham. Departing from its usual procedure, the club dispensed with a guest speaker on this occasion. Instead, some forty-five members and guests met and enjoyed the opportunity for informal talks with other members of the industry. This meeting marked the end of the present series of luncheon meetings, the next being arranged for September.

Technical Liaison Experiment

How to bridge the gap between research institutions, with their store of valuable knowledge, and small and medium-sized firms lacking in scientists and technologists is the subject of a booklet—"Small Firms with Big Problems"—published by the Department of Scientific and Industrial Research. As the title implies, many small firms have serious technical and organizational difficulties which might be solved easily if they could find the right information at the right time. As an experiment, a Technical Liaison Service—the first of its kind in Britain—was set up by the Scottish Council (Development and Industry) with Conditional Aid funds.

A team of three investigators visited industrial firms—to find out their problems and, if possible, to find answers to them. During the survey, the Technical Liaison Service helped 109 firms, each with less than 500 employees and without elaborate management organization. They dealt successfully with 160 out of 223 questions posed, including design, production, sales and financial problems. None of these could have been solved by the firms' own resources.

"Small Firms with Big Problems" is a summary of the Scottish Council's full report, and gives a brief account of the service in action. For example, ten questions were passed on to the Mechanical Engineering Research Laboratory D.S.I.R., at East Kilbride, near Glasgow. And three Research Associations proved outstandingly useful. A new liaison service, based on this experiment, is expected to open in Glasgow shortly, and other industrial regions in Britain are showing an interest which may lead to an adoption of similar schemes. In fact, one scheme has already been launched in Birmingham.

Extended Activities

Under the leadership of their parent company, **B. O. Morris Limited,** the "Morrisflex" group of companies continue to extend their interests and activities in the field of metal finishing. The group has now concluded an arrangement with the Wallace Corporation of America to manufacture, under licence, in this country Wallace tube benders and Wallace abrasive cut-off machines.

These machines are stated to enjoy a very high reputation in the U.S.A., and the Morris companies are establishing a complete organization here to manufacture and distribute these tools.

Scientific Research

A further edition of "Scientific Research in British Universities" is now published and covers the period 1957-58. This is an annual publication, stated to be the only one of its kind in this country, which outlines the scientific research being carried out in British universities and university colleges. It covers the natural sciences, engineering, and other forms of technology, medical and agricultural studies, but excludes the social sciences, among them economics.

Entries are grouped under university departments, and include the names of research workers and the titles of projects. Together they indicate the scope of work in each department and in each research team. Full name and subject indexes make reference easy. The material is collected by the British Council from the heads of university departments. It is issued by the D.S.I.R. with the agreement of the Agricultural Research Council and the Medical Research Council.

The book may be obtained from any branch of H.M. Stationery Office at £1 2s. 6d., by post £1 3s. 5d., or through local booksellers.

City and Guilds Institute

New and revised schemes for the session 1958-59 have been introduced by the **City and Guilds of London Institute** in the regulations and syllabuses of existing subjects for that coming period. A summary of these schemes is provided in a twelve-page pamphlet just issued by the institute.

In connection with metal finishing, the former intermediate and final examinations (including electrodeposition of metals) have been replaced by a new scheme in metal finishing technology, including new regulations for the award of full technological certificates. Also,

the syllabuses in certain sections of the non-ferrous metals operatives' course have been reworded.

The subject of welding (electric arc and oxy-acetylene) has been revised on an entirely new basis and now provides for examinations at two levels—ordinary and advanced—instead of one as formerly. A copy of this pamphlet may be obtained on application to Gresham College, Basinghall Street, London, E.C.2.

Westinghouse Colour Film

At the annual Electronics Exhibition and Convention, which opened yesterday at the College of Science and Technology in Manchester, and which will remain open until next Wednesday, an interesting colour film is being shown by the **Westinghouse Brake and Signal Company Limited.**

This film describes the progress of Westinghouse rectifiers from the original copper-oxide type, the advance to the selenium rectifier, and the latest developments in the new semi-conductor types, germanium and silicon. Manufacturing techniques of all four types are fully described, and actual production in the Westinghouse factory is shown.

Spray Finishing

It was recently announced by **T.C. Spray Finishing Systems (Bede) Ltd.** that they have commenced carrying on the business of T.C. Spray Finishing Systems, producers of the Economatic paint heater and the Bede airless spray painting equipment.

The new board of directors comprises the original partners—Mr. Tom Cowlard, Mr. R. B. Moss and Mr. A. E. Mantell—with the addition now of Mr. James A. Bede (U.S.A.) and Mr. G. K. Sargent. The company will be represented in the Lancashire and Yorkshire areas by Mr. A. A. Dooley, who will be operating from Manchester.

A Lecture Course

A course of ten lectures has been arranged by the **Borough Polytechnic,** London, on the subject of "Refractories: Their Manufacture, Properties and Applications," to be given by Mr. L. R. Barrett, M.A., B.Sc., M.S., A.R.I.C., on Fridays at 7 p.m., commencing on October 10, 1958.

This course is organized to provide a detailed and up-to-date survey of refractories and the refractories industry. The fee for the course is £1, and a leaflet giving full details of the lectures and an application form may be obtained on application to the Polytechnic, Borough Road, London, S.E.1.

Aluminium in Ireland

It was recently announced by the **Irish Aluminium Company** at Nenagh, Co. Tipperary, that they have received a five-year contract with the Eire Department of Local Government for the supply of all "reflectorized" road traffic control signs in the Republic. This is stated to be the largest single contract handled by the factory since it was opened a few years ago. Previously these road traffic signs were imported from Britain.

News from Birmingham

Cheaper money and the relaxation of the credit "squeeze" are welcome to industrialists. The position as far as finance is concerned is easier than it has been for the past three years, and should be a big help, particularly to the small manufacturer. In the Midland area there is not much change in the industrial position. Buyers are cautious and the process of lowering stocks rather than placing fresh orders continues. The increase in unemployment in this district has not reached serious proportions, though it is significant that a good deal of overtime has been cut out, and firms which not so long ago were seeking labour now have a surplus. Activity in the motor and allied trades remains on a high scale.

The engineering industries continue good customers for steel, particularly those engaged on rolling stock and the manufacture of heavy electrical plant. Structural business is quieter than it has been for some years, and most descriptions of structural steel can be obtained fairly promptly. Re-rollers are working short time. There is also a lack of orders for light iron castings. Supplies of pig iron are ample for all requirements, even though the number of furnaces operating has been reduced. There has been a sharp drop in the tonnage of steel imported as compared with the figure at the beginning of the year.

The second Birmingham Corporation flatted factory, a £250,000 seven-storey building at the junction of Blucher Street and Holloway Head, was opened on Monday, June 30. The two blocks of flatted factory units—the other is in Dartmouth Street—are to rehouse some of the 1,300 firms being disturbed by redevelopment schemes. The largest, in Dartmouth Street, has 46 units, and rentals vary from 5s. 6d. to 5s. 9d. per sq. ft. to 6s. to 6s. 3d. The Holloway Head block has 20 units (more if the larger units are subdivided), with rentals varying from 5s. 6d. to 6s. to 6s. 9d. per sq. ft. Individual units vary in size from 1,449 to 3,831 sq. ft. at Dartmouth Street and from 1,015 to 7,550 sq. ft. at Holloway Head.

Lettings so far (in occupation or under negotiation) are 18 at Dartmouth Street and 9 at Holloway Head. A disused tramway repair depot at Kyotts Lake Road, Sparkbrook, has also been converted into 10 factory units, all of which have either been let or are under negotiation. Among firms who have taken units in the Corporation's buildings are sheet metal workers, precision engineers and ventilating engineers, and other firms interested include machine factors, electrical heating equipment manufacturers, precision grinders and general engineers.

Publications on Aluminium

Three new editions of publications from **The Aluminium Development Association** have just been issued. The first is a directory of members of the association, and the second is a list of the various information bulletins, brochures, and Symposium series, the latter including the recent Symposium on aluminium in packaging, which was held last month.

The third publication contains a list of films, film strips and wall charts, in which nearly 60 sound films (16 mm.), available on loan, are classified under production, working operations, joining and applications, together with details of 35 mm. film strips.

An important service provided by the A.D.A. Education Department is the supply of wall charts, together with accompanying teachers' notes, which provide much-appreciated teachers' aids on aluminium production; aluminium alloys—preparation and properties; aluminium in everyday use, and production of castings.

Copies of these various publications are obtainable from the offices of the association at 33 Grosvenor Street, London, W.1.

International Nickel

A spokesman in London for The International Nickel Company of Canada Limited confirmed an announcement made in Copper Cliff, Ontario, that another curtailment in nickel production is being made effective July 14, and that the curtailment will reduce the company's production of nickel to a rate of approximately 200,000,000 pounds per year.

The announcement in Copper Cliff said: "Since our last curtailment of production, stocks of unsold nickel in our hands and in the hands of the United States Government have continued to accumulate and now total about 135,000,000 pounds exclusive of nickel in the United States Government stockpile and of unconsumed nickel in the inventories of customers. Under these circumstances, we have no alternative but to reduce our production to a rate more nearly in line with our deliveries.

"The company has a nickel production capacity at Sudbury of over 300,000,000 pounds per year, and full production can at any time be resumed with a minimum of delay. The curtailment of production does not affect our new nickel project at Thompson in Manitoba, which is scheduled for completion in 1960 and which will have a capacity of 75,000,000 pounds per year."

Previous curtailments in March and in May 1958, the company spokesman said, had lowered the company's production of nickel to a rate of approximately 250,000,000 pounds per year.

Aluminium Markets

A good deal of talk continues to be heard in regard to cheap offers of aluminium metal in the open market. While it is difficult to determine at which level firm offers are actually being made, what does seem to emerge with rather more clarity is that open market prices are still trending downwards, trade sources add. Down as low as £158 per ton c.i.f. United Kingdom has been mentioned, with payment after arrival, for Hungarian metal; so far as can be ascertained, Russia is not offering as cheaply. Metal c.i.f. Continental ports is priced at about £163 according to other informants, who added that, generally speaking, open market aluminium prices are quotably around £160. A few weeks ago a price of about £165 was talked of.

New business in Russian aluminium is virtually non-existent, trade sources said, arrivals so far this year having been contracted for earlier. A factor militating against new purchases is the still unresolved question of the British Government's intentions regarding an anti-dumping duty on Russian metal, but on this point some observers think it will be difficult for the Government to legislate against Russian metal only. Other foreign productions would have to be considered, they added, especially as Hungary and Poland have been particularly competitive for some time.

United Kingdom remelted aluminium prices have also been drifting lower, with LM.4 grade, for instance, now indicated at from £170 to £175 per ton delivered. There are few signs yet of a reversal in this trend, trade sources said.

The Canadian contract price to United Kingdom consumers remains at £180 per ton delivered. It was reduced from £197 on and from April 1 last. What effect, if any, open market conditions will have on the Canadian price remains to be seen. If low offers persist, then it could unsettle the Canadian price, especially if demand does not improve. Taking into account the Canadian "loyalty" discount of some £3 12s. 0d., and putting foreign metal on to a United Kingdom delivery basis, the latter is still some £11 to £12 per ton cheaper. Possibly, however, nothing will happen on contract prices until the British Government declares its anti-dumping duty policy.

L.D.A. "Open" Days

To mark the inauguration of the new offices of the **Lead Development Association** at 18 Adam Street, London, W.C.2, a series of "Open" days commenced on Monday last and continued throughout the week until to-day (Friday). On Tuesday, the President of the Board of Trade visited the new premises and, in addition, representatives of Government departments and Commonwealth Government offices attended.

The association, an advisory non-profit earning body, was formed by the leading Commonwealth producers of lead in 1954, the principal objects being to extend the knowledge of lead and its manifold uses, and to foster appreciation of its merits. During 1957 the affairs of the Lead Sheet and Pipe Council, which had previously operated under the aegis of the Lead Sheet and Pipe Manufacturers' Federation, were integrated with those of the association. Qualified metallurgists, who are competent to advise and assist in problems relating to the metal and its applications, supplement the established services of the technical information bureau.

B.N.F.M.F. Golf

On Friday of last week (July 4), the **British Non-Ferrous Metals Federation** held its annual golf competition at the Copt Heath Golf Club, Solihull, Warwickshire. The morning competition for the "Horace W. Clarke" Cup was won by Mr. G. Flood (D. F. Tayler and Co. Ltd.), with Mr. E. N. Rowbotham (The Ever Ready Co. (Great Britain) Ltd.) as runner-up.

In the afternoon a four-ball competition against bogey was held, and was won by Mr. R. Allen (Barker and Allen Ltd.) and Mr. G. P. Kempson (Imperial Chemical Industries Limited, Metals Division).

New Welding School

To serve industry in Northern Ireland, **British Oxygen Gases Ltd.** are to open a new welding school on October 1 next. It will be sited at the company's headquarters at Castlereagh, Belfast. This school will provide tuition in both oxy-acetylene welding and cutting and electric arc welding, and a full-time instructor will be in attendance.

Six benches will be provided for oxy-acetylene welding. An additional bench will be provided for arc welding, and equipment for this process will be supplied by Quasi-Arc Ltd. Courses in metallic arc welding will also be available. A number of cutting machines will be available for use, including the Cub, Bantam, 36 in. and P.S.L. A pipeline has been installed to provide oxygen for machines and welding benches.

The school is to be equipped with a cinema where up to 30 people can be accommodated, and lectures and demonstrations will be provided for customers' operators, and provision will also be made to enable customers to see demonstrations of special equipment and processes.

Platinum Markets

Reduced world demand for metals is affecting the business of Johnson, Matthey and Company, according to Mr. G. C. H. Matthey, chairman of the company, in his annual review. In particular, the flow of platinum from their supplier, Rustenburg Platinum Mines, had declined steadily this year. Mr. Matthey said that, while he did not predict disaster, the results for the current year, which ends on May 31, 1959, would probably fall noticeably below those of last year. But there was no doubt in the chairman's mind that the company would be able to show a good return for the capital invested in it.

An Association Handbook

Just published is the 1958 edition of the British Engineers' Association Classified Handbook of Members. This edition covers nearly 700 pages of reference matter, and includes a comprehensive list of members' products classified under more than 3,000 product headings, specially arranged to be of maximum assistance to purchasers of engineering equipment.

The classified index is repeated in French, German, Portuguese and Spanish, and the book also includes an index of trade names and marks.

Uranium in Britain

The part played by the Atomic Energy Division of the Geological Survey in the search for uranium is little known because of the security measures that have applied until comparatively recently to information on the production of nuclear raw materials.

Last year the Division, acting on behalf of the Atomic Energy Authority, undertook an airborne radiometric survey of West and Central Cornwall, and the results of this survey have so far been interesting. Several of the anomalies recorded are sufficiently marked at surface to merit pitting, trenching and exploratory drilling to prove the extent of the mineralization underground.

The area to be covered by airborne survey will be extended this year to cover the remainder of Cornwall and much of Devon and Somerset. In addition to this air reconnaissance survey, the Division is undertaking the examination of abandoned mine workings in Cornwall, where small amounts of uranium are known to occur. Only surface, or near surface, examination has hitherto been possible, but reconnaissance drilling has recently started and will continue on an increased scale during the summer season.

Bolivian Tin

Recent news from La Paz states that the Bolivian National Chamber of Mines, the organization which controls those mines which have not been nationalized, has asked the Bolivian Government to create a domestic stockpile of surplus tin ore accumulating because of International Tin Council restrictions on exports. The Chamber said it considered the tin could be sold later, when prices had improved and when the present restrictions had been abolished. Furthermore, the accumulated stocks would facilitate the granting of loans to Bolivia.

Men and Metals

Formerly sales manager of the company, **Mr. F. Gordon Kay** has been elected to the board of directors of Acheson Colloids Limited. Last year Mr. Kay was promoted to the position of manager, sales relations, of Acheson Industries (Europe) Limited, the parent body for the Acheson group of companies. He has been with the organization for 34 years.

At the annual general meeting of the British Non-Ferrous Metals Federation, held in Birmingham last week, the **Hon. John Grimston,** M.P. (Enfield Rolling Mills Limited) was re-elected President for the coming 12 months. **Dr. Maurice Cook** (Metals Division, Imperial Chemical Industries Limited) and **Mr. W. W. Dolton** (The Delta Metal Company Limited) were re-elected vice-presidents, and **Mr. W. F. Slater** (Thomas Bolton and Sons Limited), with **Mr. J. S. Clapham** (Yorkshire Imperial Metals Limited) were also elected vice-presidents. **Mr. A. L. Johnson** (Richard Johnson, Clapham and Morris Limited) was re-elected treasurer.

It has been announced by the Council of the Institution of Production Engineers that the **Rt. Hon. The Earl of Halsbury** F.R.I.C., F.Inst.P., has accepted an invitation to remain in office as President for a further year. **Mr. H. W. Bowen,** O.B.E., M.I.Mech.E., has been elected chairman of council for the ensuing year, and **Mr. R. H. S. Turner,** M.A., has been elected vice-chairman of council.

It is learned that **Mr. John C. Mantell** has been appointed assistant secretary to Birlec Limited, of Birmingham.

Manager of Edgar Allen and Co.'s electric furnaces, tropenas and heat-treatment departments, **Mr. W. H. Everard** has been appointed secretary of the Electric Steelmakers' Guild. The Guild, which was formed last year, aims to promote progress in the manufacture of steel for commercial purposes in electric melting furnaces.

Having graduated at Sheffield University this year with first-class honours in metallurgy and won the Mappin Medal and Premium, **Mr. John Beech** is to join the metallurgical research staff of the British Steel Castings Research Association.

Engaged in postgraduate research in the Department of Refractories Technology at Sheffield University under a bursary provided by the British Steel Castings Research Association, **Mr. Michael Palfreyman** has been awarded the Frank Holland Memorial Prize by the University.

New President of the Scientific Instrument Manufacturers' Association of Great Britain is **Mr. Raymond Barrington Brock,** M.B.E., F.R.I.C., B.Sc. Elected vice-presidents are **Mr. L. A. Woodhead** and **Mr. P. Goudime.**

Metal Market News

JUDGING by the tempo of trade last week, the seasonal summer quietness has set in early this year, and the outlook for the weeks that lie ahead is not very bright. The amount of metal changing hands on the Metal Exchange was certainly less than usual, and even the turnover in copper futures in New York suffered a setback. Both lead and zinc showed up badly, for at the beginning of the week it became known that the United States Senate Interior Committee had rejected the idea of stockpiling these two metals. As from July 1, the import duty of 1·7 cents levied on foreign copper entering the U.S.A. became effective, and this development was almost certainly instrumental in depressing the standard market in London. In midweek, Phelps Dodge moved their price up by 1½ cents to 26½ cents, so as to be in line with Anaconda, and it remains to be seen how long Kennecott will wait before following this lead. This upward adjustment had no effect on the London quotation for copper, which during most of the week looked rather droopy. With Kerb dealing, which was not up to the average of recent weeks in volume, the turnover in copper amounted probably to close on 6,000 tons, the close on Friday afternoon being £193 5s. 0d. cash and £194 10s. 0d. three months. These prices showed losses of £5 10s. 0d. and £5 respectively, but actually these were above the lowest, which were registered on the official market of the same day, viz. £191 15s. 0d. cash and £192 15s. 0d. three months. Business in copper on this side of the Atlantic has certainly turned very quiet, and it does not appear that the situation is much better in America, in spite of the fact that in midweek the custom smelters raised their quotation by 50 points to 26 cents.

Reference has already been made to the heaviness of the zinc and lead prices, and during the week the U.S. lead quotation was reduced by ½ cent. The turnover in lead amounted to about 4,700 tons, and at £72 for prompt and £73 7s. 6d. forward, losses of £3 10s. 0d. and of £3 5s. 0d. were registered for the respective positions. The close was well above the lowest, for at one time prompt metal stood at £71 15s. 0d. while forward was offered at £72 15s. 0d. Zinc also lost ground and, after falling to £62 15s. 0d. prompt and £63 forward, a rally at the end of the week brought these up to £63 and £63 10s. 0d. The turnover was about 6,400 tons and on balance both positions lost £2 17s. 6d. As already mentioned, this weakness must be ascribed to the abandonment of the American stockpiling plan, but it must be presumed that the subsidy plan will go forward. Both zinc and lead have suffered a sizeable setback from the high points touched only a short time ago, but they do not command much confidence at present.

Independence Day was celebrated in America last Friday and all markets were closed in consequence. Traditionally, July 4 marks the beginning of the holiday season in the United States, so that it need not occasion any surprise if business on the other side of the Atlantic is henceforward on the quiet side. The big rally in the copper quotation during the first half of June undoubtedly brought in a good many buyers, and a big business was done. At any time of the year this burst of activity would have been followed by a quiet spell, but this time the rush to cover came just before the holiday season was due to start.

New York

On July 1 a copper tariff was reimposed under the U.S. Internal Revenue Code. The excise tax of 1·7 cents per lb., which had been suspended since May 1951 by successive Acts of Congress, is applied to copper and certain copper bearing items. This year Congress took no action on extension of the duty suspension and the tariff was imposed. Originally, under the Tariff Act of 1930, the excise copper tax was four cents a lb., but was reduced to two cents under the Geneva trade agreement. The G.A.T.T. 1956 agreement allows for reduction of five per cent on the excise effective June 30, 1956, 1957, and 1958, provided the domestic price is above 24 cents.

A number of copper sources believe that with the imposition of the tariff those producers who are quoting 25 cents a lb., Kennecott and Phelps Dodge, may narrow the gap between their price and the 26½ cents price of Anaconda. However, other well-informed copper figures close to day-to-day developments said they could not see any price increase developing until copper demand improved. After the speculative flurry when the copper stockpile plan was first broached by the Secretary of the Interior, copper buying has fallen back to more modest proportions.

With the 1·7 cent per lb. duty and the current L.M.E. copper price, trade sources reckon that it costs a U.S. consumer about 28 cents per lb. to buy copper on the London Metal Exchange and have it shipped to a mill in the Connecticut Valley. This would not include a premium currently charged in London for copper wire bars. This consideration may be paramount in the near price trend in copper here, notwithstanding slackened copper demand, a number of copper traders have indicated.

A big development in the week was the Senate Interior Committee's Minerals Bill, which was submitted to the Senate. This Bill provided for Government stockpiling of copper for one year, but rejected lead and zinc stockpiling. However, it raised the support price of lead and zinc buying by the Government to 15½ cents for lead and 13½ cents for zinc, with a provision for four cents differential between the market price and what the Government could pay. Thus, in zinc a producer could price his metal at 9½ cents and sell to the Government at 13½ cents.

The lead/zinc industry was disappointed that the Senate committee had eliminated the plan for stockpiling of lead and zinc, but took some comfort in the increased support price levels, ¾ of a cent above what Mr. Seaton had recommended, and the 4 cents differential between market and maximum support price. Lead was quiet during the week, while zinc was spotty. Tin was quiet and lower in price. Traders said that consumer interest was lacking and dealers were buying meagrely.

Australia

A warning that quality and cost of Australian goods "must be right" to meet expected increases in overseas and local trading has been given in Melbourne by the Minister for Trade, Mr. John McEwen. "There is a move towards times of sharper competition in world trading and sharper competition in Australia," he said.

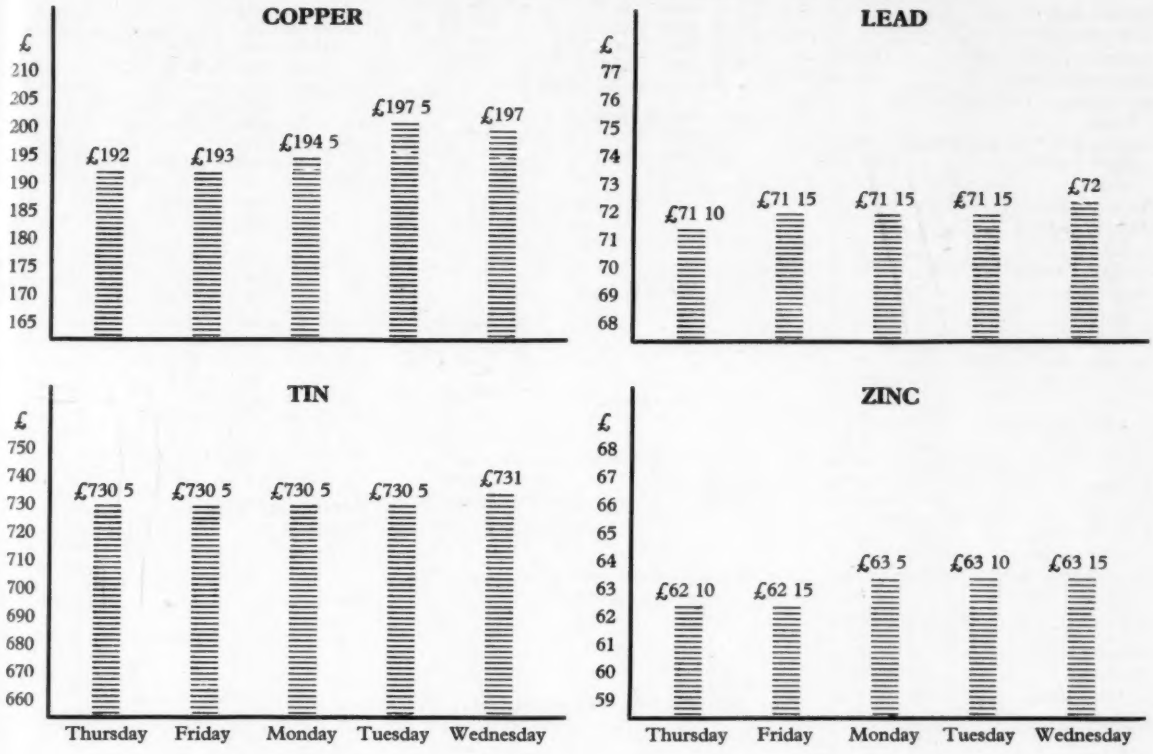
Mr. McEwen was speaking at a luncheon given by the Zinc Alloy Die Casters' Association of Australia to launch a new scheme aimed at ensuring first-class quality for Australian-made zinc alloy castings. He said the Federal Government was very anxious to see Australian industry expand, and there could be no sure expansion except on the basis of all-round efficiency. The Government's policy was to provide adequate protection for Australian industry, but for many years Australia had been obliged to permit competitive entry of United Kingdom products.

He congratulated the Association on the new scheme, which was similar to others already operating in the U.K. and the U.S. The benefits of the Australian scheme would be a wider confidence in zinc alloy castings in industry and, subsequently a wide use of them.

Trade talks between the New Zealand and Australian Governments have been going on in Wellington during the last few days, and among the subjects discussed is that of the revision of the 1933 trade agreement between the two countries and the redressing of the £40m. trade balance in Australia's favour.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 3 July 1958 to Wednesday 9 July 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton	Canada c/lb ≏ £/ton	France fr/kg ≏ £/ton	Italy lire/kg ≏ £/ton	Switzerland fr/kg ≏ £/ton	United States c/lb ≏ £/ton
Aluminium		22.50 185 17 6	210 182 15	375 217 10		26.10 208 17 6
Antimony 99.0			195 169 12 6	430 249 10		29.00 232 0
Cadmium			1,500 1,305 0			155.00 1,240 0
Copper						
Crude						
Wire bars 99.9				390 226 5		
Electrolytic	27.50 201 0	24.00 198 5	250 217 10		2.30 192 7 6	25.00 200 0
Lead		10.50 86 15	110 95 15	182 105 10	.93 77 15	11.50 92 0
Magnesium						
Nickel		71.50 590 10	1,205 1,048 7 6	1,300 754 0	7.80 652 5	74.00 592 0
Tin	102.25 747 10		903 785 12 6	1,400 812 0	8.60 719 2 6	95.00 760 0
Zinc						
Prime western		10.00 82 12 6				10.00 80 0
High grade 99.95		10.60 87 10 0				
High grade 99.99		11.00 90 5				
Thermic			107.12 93 2 6			
Electrolytic			115.12 100 2 6	159 92 5 0	.82 68 10	11.25 90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 9/7/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite per unit			—	
Copper H.C. Electro	ton	197	0	0
Fire Refined 99·70%	„	196	0	0
Fire Refined 99·50%	„	195	0	0
Copper Sulphate	„	70	0	0
Germanium	grm.		—	
Gold	oz.	12	9	11½
Indium	„		10	0
Iridium	„	22	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	0	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	77	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	25	0	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3
Tellurium	lb.		15	0
Tin	ton	731	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	17	6
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	17	6
Granulated 99·99+%	„	101	12	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

		£	s.	d.
Aluminium Alloy (Virgin)				
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†**Aluminium Alloy (Secondary)**				
B.S. 1490 L.M.1	ton	150	10	0
B.S. 1490 L.M.2	„	157	10	0
B.S. 1490 L.M.4	„	177	10	0
B.S. 1490 L.M.6	„	192	10	0

†Average selling prices for May

***Aluminium Bronze**				
BSS 1400 AB.1	ton	201	0	0
BSS 1400 AB.2	„	214	0	0
***Brass**				
BSS 1400-B3 65/35	„	135	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	175	0	0
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	164	0	0
(86/7/5/2)	„	174	0	0
(88/10/2/1)	„	233	0	0
(88/10/2/½)	„	236	0	0
Manganese Bronze				
BSS 1400 HTB1	„	171	0	0
BSS 1400 HTB2	„	191	0	0
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	249	0	0
Phosphor Copper				
10%	„	220	0	0
15%	„	227	0	0

**Average prices for the last week-end.*

Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	344	9	0
Grade D Plumbers	„	279	0	0
Grade M	„	377	9	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	94	17	6
Mazak V	„	98	17	6
Kayem	„	104	17	6
Kayem II	„	110	17	6
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet	10	S.W.G. lb.		2	8
Sheet	18	S.W.G. „		2	10
Sheet	24	S.W.G. „		3	1
Strip	10	S.W.G. „		2	8
Strip	18	S.W.G. „		2	9
Strip	24	S.W.G. „		2	10½
Circles	22	S.W.G. „		3	2
Circles	18	S.W.G. „		3	1
Circles	12	S.W.G. „		3	0
Plate as rolled		„		2	7½
Sections		„		3	1½
Wire 10 S.W.G.		„		2	11
Tubes 1 in. o.d. 16 S.W.G.		„		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M. Plate as rolled	„		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP. Plate heat treated	„		3	5½
BS1475. HG10W. Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP. Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP. Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	6½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	219	0	0
Extruded Bar	lb.		1	9½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	157	0	0
Condenser Plate (Naval Brass)	„	167	0	0
Wire	lb		2	4⅜
Copper Tubes	lb.		1	10½
Sheet	ton	224	5	0
Strip	„	224*	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	241	15	0
Cupro Nickel Tubes 70/30	lb.		3	3½
Lead Pipes (London)	ton	115	0	0
Sheets (London)	„	112	15	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3¾
Wire 10%	„		3	10½
Phosphor Bronze Wire	„		3	7½
Titanium (1,000 lb. lots)				
Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-	
Rod 4″ dia.-·250″ dia.	„	75/-	112/-	
Wire under ·250″ diam.-·036″ diam.	„	146/-	222/-	
Sheet 8′×2′×·250″-·010″ thick	„	88/-	157/-	
Strip ·048″-·003″ thick	„	100/-	350/-	
Tube (representative gauge)	„		300/-	
Extrusions	„		120/-	
Zinc Sheets, English destinations	ton	97	10	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 8/7/58.

	£
Aluminium	
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	119
Rod Ends	117
Heavy Yellow	102
Light	97
Rolled	112
Collected Scrap	100
Turnings	110
Copper	
Wire	165
Firebox, cut up	165
Heavy	158
Light	153
Cuttings	165
Turnings	150
Braziery	130
Gunmetal	
Gear Wheels	160
Admiralty	160
Commercial	134
Turnings	129
Lead	
Scrap	63
Nickel	
Cuttings	—
Anodes	440
Phosphor Bronze	
Scrap	134
Turnings	135
Zinc	
Remelted	55
Cuttings	42
Old Zinc	31

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£165.7.6)	190
Heavy copper	(£165.7.6)	190
Light copper	(£143.0.0)	170
Heavy brass	(£104.10.0)	120
Light brass	(£82.12.6)	95
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	(£565.10.0)	650
Aluminium	(£117.10.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£110.5.0)	190
Lead, soft, first quality	(£84.12.6)	146
Lead, battery plates	(£49.17.6)	86
Copper, first grade	(£188.10.0)	325
Copper, second grade	(£177.0.0)	305
Bronze, first quality machinery	(£188.10.0)	325
Bronze, commercial gunmetal	(£159.10.0)	275
Brass, heavy	(£130.10.0)	225
Brass, light	(£119.0.0)	205
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

A. Cohen and Co. Ltd.

Final dividend 16½ per cent, making 22½ per cent for 1957 (same). Group net profit £111,961 (£109,553), after tax of £50,803 (£99,888).

Metal Industries Ltd.

It is reported by the company that its recent offer to stockholders of £1·5 million ordinary stock in The British Oxygen Company Limited has been fully successful. Of the £1,297,700 stock available to ordinary stockholders under letters of entitlement, £1,257,515 has been taken up. For the remaining £242,485 stock, which was offered to both ordinary and preference stockholders, applications totalled £1,194,015, or nearly five times the amount available.

Davy Paxman and Co. Ltd.

Trading profit year to March 31, 1958, £584,365 (£428,187) and contracts profits earlier years £64,252 (£89,251). After depreciation £172,796 (£177,852), to increased cost of plant replacement £20,000 (same), loan interest £12,500 (nil), profits tax £48,000 (£42,500), income tax £203,559 (£155,000) and tax equalization credit £5,500 (£7,800), net profit is £197,863 (£130,488). To general reserve £100,000 (£40,000), dividends, net, £80,500 (same), forward £153,523 (£136,160). Fixed assets £1,119,065 (£1,149,488). Net current assets £2,991,118 (£2,266,700). Unsecured loan stock £500,000 (nil)—subscribed at par by parent company.

Head Wrightson and Co Ltd.

Consolidated balance sheet shows fixed assets £2,265,439 (£1,943,306), investments in associated companies £391,434 (£271,434), current assets £5,940,662 (£4,721,786) and liabilities £3,437,687 (£2,461,214). The balance of group capital expenditure authorized is estimated at £813,000. The authorizations are expected to take three years to complete.

Group trading profits, etc., of £1,757,581 (£1,466,921) created a record. The 17½ per cent dividend on larger capital represents a 2½ per cent increase.

Quicksilver Price Up

For physical supplies of quicksilver on the spot, London dealers now suggest a price of £77 per flask ex warehouse London. For the past two months or so the price has stood at £76. Available supplies are not too flush, trade sources say. They believe that at the lower levels recently reached, Mexico preferred to sell direct to the United States General Services Administration at the guaranteed price of 205 dollars f.o.b., or about £73¼, which was only fractionally less than the c.i.f. United Kingdom price at that time.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for April, 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	2,308
Imports	7,522
Despatches to consumers	19,058
Secondary Aluminium	
Production	8,440
Virgin content of above	821
Despatches (including virgin content)	8,208
Secondary in Consumption (per cent)	
Wrought products	4·1
Cast products	85·0
Destructive uses (aluminium content irrecoverable)	75·7
Total consumption	29·0
Scrap	
Arisings	12,303
Estimated quantity of metal recoverable	8,720
Consumption by:	
(a) Secondary smelters	10,431
(b) Other users	1,033
Despatches of wrought and cast products	
Sheet, strip and circles	10,449
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,352
(b) Tubes (i) extruded	199
(ii) cold drawn	555
(c) (i) Wire	1,525
(ii) Hot rolled rod (not included in (c) (i))	59
Forgings	343
Castings: (a) Sand	1,592
(b) Gravity die	3,739
(c) Pressure die	1,359
Foil	1,758
Paste	232
Magnesium Fabrication	
Sheet and strip	5
Extrusions	50
Castings	152
Forgings	1

LIGHT METALS STATISTICS IN JAPAN

(March, 1958)

Classification	Production	Shipment	Stock	Export
Alumina	15,434	12,803	16,757	0
Aluminium				
Primary	6,511	6,550	2,419	1,035
Secondary	1,908	1,950	291	0
Rolled Products	5,929	5,946	1,564	611
Electric Wire	1,611	2,066	951	399
Sheet Products	1,476	1,465	902	78
Castings	1,713	—	—	—
Die-Castings	956	—	—	—
Forgings	12	—	—	—
Powder	—	—	—	—
Primary Aluminium (April)	6,782	6,393	2,808	223
Sponge				
Titanium	137	190	722	188
Magnesium	67	68	0.3	0
Secondary	220	176	238	0

THE STOCK EXCHANGE

Turnover Expanded A Little And Undertone Generally Firm

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 8 JULY +RISE —FALL		DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	20/6		9	10	8 15 6	21/3	17/9	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	50/–	+3d.	15	15	6 0 0	51/–	47/–	72/3	47/9
1,590,000	1	Birfield Industries	51/–	+1/6	15	15	5 17 9	53/9	46/3	70/–	48/9
3,196,667	1	Birmid Industries	67/3	—3d.	17½	17½	5 4 0	68/–	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	27/4½	—3d.	10	8	7 6 0	28/6	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½		6	6	7 4 3	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	25/–		12½	12½	10 0 0	28/9	25/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/6		5	5	6 9 0	16/–	15/3	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/4½		7	7	7 4 6	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	45/–	+1/3	12	12	5 6 9	46/6	37/–	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/–		6	6	6 6 3	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	43/3		12½	12½	5 14 3	45/6	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	34/3	—3d.	10	10	5 16 9	35/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/–		25+*2½C	25	6 5 0	21/–	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/9		25	25	10 0 0X	2/3	1/9	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/1½	—1½d.	25	25	12 2 6	4/9	4/1½	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	18/–		10	10	11 2 3	18/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/9		6	6	7 12 6	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	2/9		20	25	14 11 0	4/6	2/9	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	47/6		18¾	22½	7 18 0	51/6	42/6	92/6	49/–
1,136,233	1	Davy & United	51/3		15	12½	5 17 0	51/3	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	20/6		30	*17½	7 6 3	21/4½	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	33/6	+6d.	12½	15B	7 9 3	34/–	24/–	38/6	25/–
750,000	1	Evered & Co.	27/6xcap		15Z	15	7 5 6	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	32/4½	+4½d.	12½	14	7 2 3Y	38/7½	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	31/3	+6d.	20	17½	6 8 0	33/9	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/–	—9d	15	15	4 15 3	66/3	63/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/9		11½	11½	10 0 0	6/6	5/7½	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	14/1½		20	20	7 1 6	14/1½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	24/6	+3d.	13‖	18Z	5 6 0	24/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	48/9xd	+1/1½	20	17½	8 4 0	49/3	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	13/4½	+1½d.	*15	*15	5 12 3	13/4½	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	7/6		10	20‡	6 13 3	7/7½	6/9	10/4½	6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	28/6xcap	—3d.	12Z	10	5 12 3	30/4½	27/9	46/6	36/3
33,708,769	Stk (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	143½		$3.75	$3.75	4 13 9	148½	132½	222	130
430,000	5/–	Jenks (E. P.), Ltd.	7/10½	—1½d.	27½¢	27½	8 14 6	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	44/–		10	9	4 11 0	44/–	87/6	58/9	40/–
600,000	10/–	Keith, Blackman	20/–		17½	15	8 15 0	20/–	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/3	—1½d.	10	10	9 8 3	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	44/9	+3d.	12½	12½	5 11 9	45/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/3		7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	34/–	+1/6	15	15	8 16 6	35/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	33/–	+1/9	15	15	9 1 9	33/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	9/6		20	27½‡	10 10 6	10/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	52/9	+1/6	11	11	4 3 6	52/9	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	7/1½		50	50	14 0 9	7/1½	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	19/–xd		10	10	10 10 6	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	79/6xd		6	6	7 11 0	83/6	79/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	37/6		10	10	5 6 9	40/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3	+3d.	5½	5½	6 7 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	55/9	—6d.	20	20	7 3 6	58/9	53/3	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	8/7½		10	10	5 16 0	8/7½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/9		20	27½D	7 15 3	27/–	25/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	13/7½	+6d.	17½Z	15	4 5 6	13/7½	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	52/–xd	+2/–	18	16	6 18 6	52/–	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/3	+9d.	6½	6½	6 8 6	20/9	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	55/3	+6d.	15	15	5 8 6	55/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	29/10½	—1½d.	10	10	6 14 0	32/6	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/9	+6d.	*5	*5	7 2 6A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	76/9	—6d.	20	15	5 4 3	77/3	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	38/6	—6d.	10	18P	5 4 0	40/–	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/1½		25	40	7 0 3	8/–	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	17/9xd	+3d.	27½	27½	7 15 0	18/–	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6		20	17½E	14 5 9	3/9½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/3		6	6	10 13 3	11/6	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/1½		27	40D	12 14 0	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized Issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ¢ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.